THE REST OF THE WORLD GETS A TASTE OF WHAT IT'S LIKE TO DEAL WITH AVALANCHES.

39.1
OCTOBER 2020

THE AVALANCHE REVIEW

LIVING WITH

UNcertainty...

AMERICAN AVALANCHE ASSOCIATION

AN ALTERED WORLD: The Heather Meadows weather station (4200 ft) recorded 9 inches of rain and 20 inches of snowpack settlement between January 31–February 1, 2020, making for a wet and wild end to an incredible snowfall month. (Mt. Baker Ski Area reported 294 inches of snowfall in January). During this 48-hour rain event, a widespread glide avalanche cycle occurred throughout the North Cascades and the snowpack was dramatically altered. Cool temperatures followed on February 2, refreezing deep rain rills at the snow surface, as seen here on Mt. Baker's Easton Glacier (SW, 5600 ft). *Photo Andrew Kiefer*

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Photo: BCA splitboard athlete Kam Weakley, San Juan Mountains, CO. Photo: @jeffcricco

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AMERICAN AVALANCHE ASSOCIATION

A3 STATEMENT OF PURPOSE

The American Avalanche Association promotes and supports professionalism and excellence in avalanche safety, education, and research in the United States.

THE AVALANCHE REVIEW

The Avalanche Review is published each fall through spring by the American Avalanche Association, Inc., a nonprofit corporation. For a digital version of this publication, see theavalanchereview.org. *The Avalanche Review* welcomes the submission of articles, photographs, and illustrations.

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LIVING WITH UNCERTAINTY

IF YOU ARE LOOKING FOR CERTAINTY, YOU CAME TO THE WRONG PLANET.

FEATURE STORIES

DEPARTMENTS

Remote **A**valanche **C**ontrol **S**ystems

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Mike Buotte is the Snow Safety Director for Big Sky Ski and Summer resort. Hailing from Rumpford Maine, Mike headed west to Montana in the early 1990s to research lift operations and obtain a degree in powder appreciation at the University of Bridger Bowl.

Karl Birkeland works as the Director of the Forest Service National Avalanche Center. He has worked for forty as a ski patroller, backcountry avalanche forecaster, avalanche researcher, and program leader. He enjoys spending time in the mountains with his wife and two daughters.

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Rob Coppolillo is a mountain guide and writer living in Chamonix, France. His latest book, *The Ski Guide Manual* (Falcon Guides), should be out by the time you read this. You may purchase a copy directly from ChauvinGuides.com, find it on Amazon, or come to Cham and get one in person. Hit him at info@vettamountainguides.com

Doug Braumberger lives in Hailey, Idaho, and spends his winters as an Accident Investigation Specialist and ski patroller for Sun Valley Resort. When not skiing you'll find him mountain biking, peak bagging, and hiking with the dogs and wife Linda.

FROM THE EDITOR

BY LYNNE WOLFE

Dan, Lynne, and Lucky Dog. *Photo Peter Thurston*

So far, 2020 has been a tumultuous year on large and small scales. In addition to the obvious factors (Covid, race riots, catastrophic fires, and on a personal scale, knee replacement), we've lost some towering figures in our country and our avalanche community: RBG, John Lewis, John Prine, Mario Ruiz, and Sam Wyssen (see TAR 39.2 for an obit) and now, closer to home, Art Judson and Tom Kaveney, our A3 ED Dan Kaveney's dad. We've also lost 200,000 (as of print date) other vital personalities; we mourn them all and valiantly adapt to a brave new world with masks and distance. Here at A3 and TAR, we try to close the distance by invoking and promoting community.

As McKenzie and I were putting together this TAR, we chose the cover photo, refrozen rain rills in the Cascades from Andrew Kiefer, as an apt representation of the beauty and form that can be found in truly shitty conditions. As avalanche practitioners, part of our assignment is acting during times of uncertainty. Starting page 30, you'll find a range of Covid musings that chart paths through our current uncertainties, using our avalanche behaviors as basis. Let us know what resonates with you, do you agree, disagree, want to elaborate?

We've chosen to print half of our avalanche center season summaries in this issue, saving the other half for 39.2 in order to focus on our smaller centers. I need to thank Alex Marienthal of the Gallatin NFAC for wrangling the summaries; I couldn't do this without you, Alex. I'm fascinated by how each center handled the uncertainty presented by Covid. Some stayed open, some closed; for each it was a considered and difficult decision. This coming season will present many similar challenges and some we have not yet encountered. Our avalanche training will once again give us tools for dealing with further uncertainty.

If you haven't checked out our new digital TAR, **theavalanchereview.org**, go have a look. You'll find a curated collection of our favorite stories from the last 15 years of TAR. Let me know if there's something you'd like to see, and FYI, we'll be highlighting LaChapelle's *The Ascending Spiral* sometime this fall.

Keep it tight,
Lynne

Copper Mountain on Banner Summit after roughly 20" of snow in 48 hours and a 6.5 magnitude earthquake. *Photo Jamie Weeks*

Honoring the mountains.
Honing self-reliance.
Teaching the young about both.
Breaking trail when we can.
Fighting for winter because we must,
and celebrating in between.
Because the tracks we set
define the legacy we leave.

Moving slow, and low, across the Bonney Glacier under convective skies.
Unknown skiers. Rogers Pass, Glacier National Park, British Columbia.
RYAN CREARY

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When does the well-being of the community at large outweigh our personal freedom to recreate?

—Doug Braumberger

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FROM THE EXECUTIVE DIRECTOR

BY DAN KAVENEY

When writing this column I make it a practice to look back at the last column I wrote—in this case *From the Executive Director* in TAR 38.4—in an effort to see how things have changed in the intervening months. It now seems to me that column was written in a different world; and in some ways it was. When I wrote it, the Covid-19 situation was just transitioning from a distant echo impacting "somewhere else" to a real threat here in North America. Since then it has seeped into the pores of our society and impacted almost all of our activities: from the most mundane to the most fundamental. A3 is no exception, and the board and staff were forced to adapt quickly to the emerging realities of a Covid-infected world.

As the practical ramifications of the Covid pandemic came in to focus neither the board nor I thought we should attempt a "business as usual" approach to the 2020–21 season. It was clear we needed to plan for a lower level of income than we enjoyed in 2019–20, while also maintaining as high a level of our traditional activities as possible. I've never been a supporter of making uniform cuts across the board in order to achieve budget objectives, so I asked the board to direct me toward those services and activities they thought would be most important to the avalanche community during the 2020–21 season. The board and I agree that all of the things we do are important to the avalanche world, but since that world has been shifted by the Covid pandemic, it seemed likely that shifts in our near term priorities should be undertaken. **What should we do differently to make ourselves as useful as possible to our members given the new realities we're all facing in the coming year?**

After much deliberation, the board has instructed me to prioritize activities and programs that "build and maintain community" for the avalanche professionals and committed recreationists who make up our membership. They have further instructed me to focus on activities and programs that most directly benefit the most members. In the service of these objectives I'll be increasing investment and activity in some of our programs, and, until the world stabilizes into some new, more predictable equilibrium, temporarily stepping back from investment and activity in other areas. We'll be focusing on the following specific activities this coming season:

- Snow and Avalanche Workshop Grants. We're moving full steam ahead with SAW support. As of this writing all of the SAW organizers have at least provisionally decided to move 100% online this fall. A3 has maintained or increased SAW support relative to last year for every SAW that applied for a grant.
- *The Avalanche Review* will move ahead as normal in printed format. In addition to the printed version of *The Avalanche Review* we've just launched a new online version of the journal. The online version will be based on, but different from, the printed version, and will feature articles that are well supported by rich media, timeless articles that are good

to have at one's fingertips, and articles that are particularly timely. Check out TAR's online cousin at **theavalanchereview.org**.

- The annual member meeting will be held 100% online this year, at 6 PM MST on Thursday, November 5. The fully online format will allow us to be much more inclusive of our widely-dispersed membership because it will be easy to attend from anywhere. Log-in details will be forthcoming via email. Remember—this is an election year and the annual meeting is where we'll finalize your new slate of board members.
- We'll be introducing a new monthly online seminar series immediately following the annual membership meeting on November 5. This series will run monthly from November through March. We plan on featuring topics of particular interest to practicing professionals, aspiring professionals, and committed recreationists. The series will be free to A3 members. Please stay tuned to your email for further details.
- The inclusivity project will remain a strong focus for the coming season as A3 continues to promote the participation of women and BIPOC people in the field and as A3 members.
- We can't maintain community if people can't stay on as members so, until further notice, we'll be continuing our free membership extensions and discounted annual membership for those whose livings have been impacted by the Covid situation and for whom paying continued membership dues would pose a financial hardship. Members interested in taking advantage of this offer should email dan@avalanche.org for details.
- Our support of the Pro Training Program will continue during the 2020–21 season.

The board has decided, at least for the moment, to put our research grants, scholarship, and publishing programs on hold. We remain strongly committed to all of these ventures, but believe the wise course will be to remain conservative about our commitments to these activities and programs until the impacts of the Covid reveal themselves a little more clearly. We will be re-starting all of these programs at the earliest feasible juncture.

Despite all the challenges facing us at the moment, I am very bullish on both our near term and long term futures. We have a great organization supported by a lot of dedicated, passionate people. Membership numbers are up year on year, and renewals are holding steady. Our corporate sponsors have stuck with us even through their own periods of great uncertainty. This kind of loyalty is really meaningful to your organization, and I hope you will talk up and patronize those companies who have invested in you, your industry, and your organization whenever you can. While it's impossible to predict the future, I think we're about as well prepared for whatever it throws at us as we can be, and I'm confident in our ability to adapt.

As always, I'm very interested in learning your ideas about how to move the organization forward. I'll miss the opportunity to visit with many you at the SAWs this year, but I'm still available at dan@avalanche.org or 307.264.5924.

SAW SCHEDULE

Snow & Avalanche Workshops

To see the full schedule and find links for each event, visit:
www.americanavalancheassociation.org/events

OCTOBER

Virtual Snow Science Workshop
virtual!
October 4–6, 2020

Colorado Snow & Avalanche Workshop
virtual!
October 14–16, 2020

Montana State University Snow & Avalanche Workshop
Bozeman, MT
October 21, 2020

Northwest Snow & Avalanche Workshop
virtual!
October 20, 22, 27, & 29, 2020

Wyoming Snow & Avalanche Workshop
virtual!
October 23–24, 2020

California Snow & Avalanche Workshop
virtual!
October 24, 2020

Four Corners Snow & Avalanche Workshop
Silverton, CO
October 2020

NOVEMBER

Utah Snow & Avalanche Workshop
virtual!
November 6 & 10–12, 2020

Southcentral Alaska Avalanche Workshop
virtual!
November 6, 2020

Bend Snow & Avalanche Workshop
virtual!
November 14, 2020

Northern Rockies Snow & Avalanche Workshop
virtual!
November 14, 2020

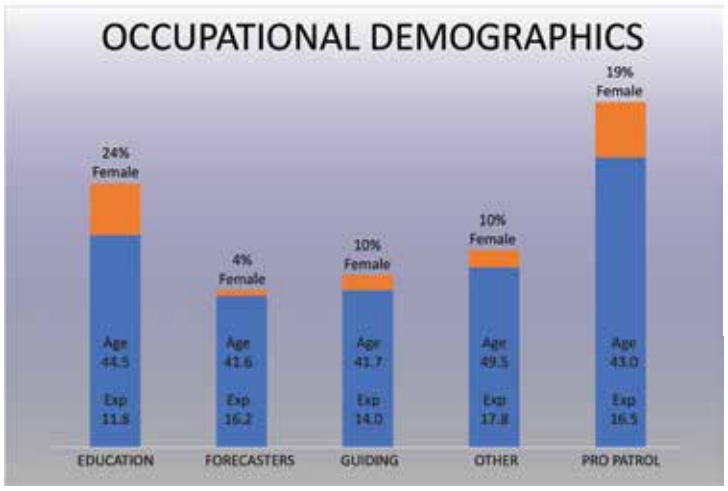
SPRING

Sawtooth Avalanche Center Professional Development Seminar
Ketchum, ID
March 2021

Gallatin Professional Development Seminar
Bozeman, MT
April 2021

2020 CENSUS OF AVALANCHE PROFESSIONALS IN THE U.S

BY KATIE WARREN, EEVA LATOSUO, JOHN STIMBERIS, & HALSTED MORRIS



To promote diversity, recruitment, retention, and professional development in the avalanche industry, it is necessary to understand the industry averages regarding wages, injury rates, and other factors that influence working conditions. We developed a comprehensive survey that was distributed through various channels in the avalanche industry to collect data on these demographics for avalanche professionals in the United States. Understanding these factors and how they compare with other industries helps to focus attention on areas of the industry in need of improvements, such as minimum professional avalanche education requirements and benefits enrollment availability. It is also vital for identifying causes and working on solutions for the lack of diversity within the industry.

We have minimal data about the demographics of the avalanche industry. The American Avalanche Association website once contained a page titled "So you want an avalanche job," where one could find a rough guess about the number of people employed in various sectors of the industry. Previously conducted surveys investigated specific subjects within the avalanche industry. We designed this survey to investigate a broad scope of demographics, working conditions, and professional training requirements within the industry. The survey included common demographic questions for all industries and focused on work-related questions specific to the avalanche industry. The survey was open for responses from November 2019 through February 2020.

RESULTS

The survey generated 628 responses (n=628), of these responses, 105 respondents began the survey but did not complete all questions; 523 (n=523) completed the survey in its entirety. For consistency of data analysis, only completed responses are included in the analytical data set, n=523. The organic method of survey distribution prohibits the calculation of a response rate. Comparing the number of responses to the total number of professional members of The American Avalanche Association reveals that the survey reached 34% of the professional group. Survey participants represented avalanche professionals from all employment sectors and regions across the United States. While all regions likely to employ avalanche professionals responded, higher percentages of responses arrived from regions where participation in winter recreation activities tends to be more significant, or avalanche activity has the potential to affect essential transportation corridors. Responses also included a wide range of experience; however, most participants had been in the industry for 20 years or less. The highest responding professions were professional ski patrollers (n= 153) and recreational avalanche educators (n=112), followed by avalanche forecasters (n=80) and winter guides (n=83). "Other" (n=95) category represented a catchall of remaining responses.

DIVERSITY

The results indicate that the avalanche industry is not a diverse workplace. Avalanche professionals are likely to be of White or Caucasian ethnicity (92%) and identify as male (85%). The data indicated that a lower percentage of women professionals was consistent for all types of avalanche related employment. Avalanche education was the only type of employment that showed a slightly higher percentage of women (24%). A significantly lower percentage of women work as guides (10%) and avalanche forecasters (3%). These data also indicate a lower retention rate for women in the industry.

WORKPLACE INJURIES

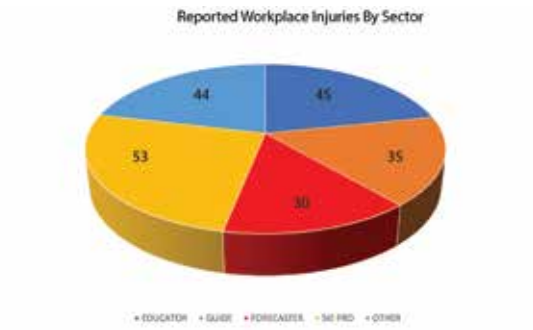
Workplace injuries occurred for 40% of avalanche professionals; of those workplace injuries, 66% resulted in a loss of work time or forced a career change. Overall, that results in 26% of avalanche professionals experiencing a workplace injury that results in a loss of work time or career change.

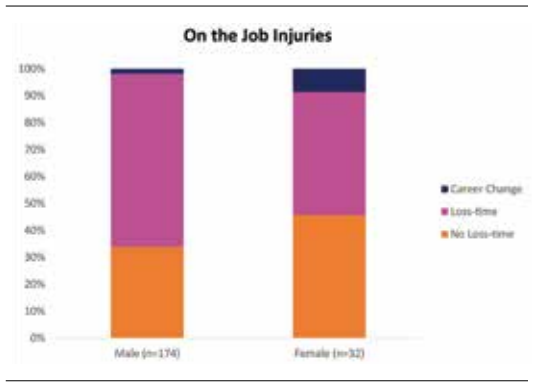
WAGES AND COMPENSATION

The average hourly, daily, and monthly wages for all avalanche professionals are $25, $251, and $5,039, respectively, and less than half of surveyed avalanche professionals responded that their compensation is adequate for the work they perform. On average, respondents that feel adequately compensated make over 15% percent more than those that do not feel adequately compensated.

BENEFITS AND EQUIPMENT

Most respondents, 59%, do not receive any benefits from the employer. When employers provide benefits, it is most likely a retirement account, followed by medical insurance, and then dental insurance. Only 39% of respondents receive an equipment allowance at an average of $240, and employers only provide personal avalanche safety equipment (transceiver, shovel, probe) for about half of the professionals. Avalanche airbags are part of the employer-provided kit for 44% of the respondents. Still, four in ten participants need to purchase avalanche safety equipment for themselves.





EDUCATION AND DEVELOPMENT

Four in ten avalanche professionals have acquired a reasonably high level of formal avalanche training for their jobs, and only three percent have no avalanche training at all. Results reflect the transition time for professional avalanche training in the U.S., and the respondents could include all the courses they have taken.

There are significant differences in training levels between industry segments; guides and educators have an obvious training path, unlike ski area workers that represent more varied training levels. A third of the employers do not specify any training level requirements for workers. The most common requirement was Pro 1, followed by (former) Level 3, and Pro 2. Of the 97% attending courses, nearly half of avalanche professionals receive some form of compensation for attendance.

The data also contains information about continuing professional development (CPD), and compensation. Employee commitment is prevalent among avalanche professionals, often beyond the requirements of a position or compensation. Avalanche workers regularly attend CPD on a regional or international scale. 74% attended a regional snow avalanche workshop (SAW), and 46% attended the International Snow Science Workshop (ISSW) at least once. Employer commitment to CPD compensation, either through wages or travel, is relatively low, with approximately 27% of employers providing compensation for wages or travel to ISSW and 32% for regional SAWs.

DISCUSSION

Avalanche professionals work in highly variable and challenging conditions, where current weather and snowpack have a significant influence on the work environment. While personal decision-making is often considered as the most influential factor in avalanche worker injuries, considering the organizational culture and complexity of the workplace could help identify accident causation and reduce future workplace incidents. This survey attempted to investigate on-the-job injuries as a whole and for different occupations within the industry. These data suggest that approximately one out of four avalanche professionals may experience a workplace injury resulting in loss of time or a career change. Further research is necessary to understand if this high percentage of worker injuries combined with relatively low wages is a factor that influences retention rates within the industry.

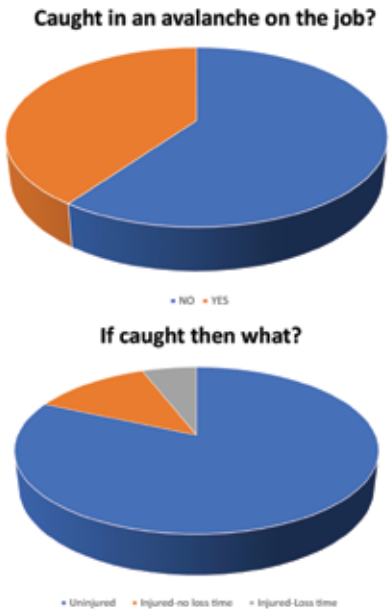
The results from this survey indicate poor retention of female avalanche professionals. Previous research in other male-dominated fields has also shown a high rate of attrition, similar to our results. Family obligations did not seem to explain female attrition in other fields, and they also may not explain why women tend to leave the avalanche industry. The argument that the masculine subculture is influencing a negative work experience for women in these male-dominated careers may also apply to the avalanche industry (The full-length article will expand on these topics). For example, data from our research indicates that a higher percentage of women work in avalanche education. Education may be often viewed as a feminine role, that women have a better perception of fit, more advancement opportunities, and encounter less backlash while ascribing to the perceived feminine role of an educator.

Continuing professional development is readily available to those in the avalanche industry. American Avalanche Association membership includes access to publications containing a variety of pertinent avalanche-related content. Regional and international workshops provide additional state of the art presentations, published proceedings, and the opportunity to network with fellow professionals. Training and CPD take time and money, so there is the matter of compensation related to professional membership and CPD attendance, and whether participation in these events provides additional job benefits. The discrepancy between employer requirements and actual formal training levels could indicate that employers place more value upon the in-house training programs and the competencies acquired through the years of work experience more than formalized training courses or standards.

CONCLUSION

This survey is a preliminary investigation into demographics and employee standards for the American avalanche industry. The avalanche industry suffers from a significant lack of diversity, possibly limiting the potential for improvement due to a lack of varied perspectives from a diverse professional group. Despite the lack of employer incentives, most avalanche professionals are highly committed to pursuing continuing professional development and education. If employers were provided more incentives or financial support to employees for these, it might increase the industry standard, while also encouraging retention and allowing for individual professional growth.

We wish to thank the American Avalanche Association Executive Board, everyone who assisted in the creation of the survey, and all of the avalanche professionals who responded to the survey.



Katie Warren serves on the A3 board of directors as Secretary. She works as a ski patroller at Stevens Pass, part-time for the WSDOT HWY 2 avalanche program, and teaches avalanche courses for Cascade Powder Guides.

Eeva Latosuo just wrapped up sabbatical year as Associate Professor of Outdoor Studies, Alaska Pacific University. She has continued curiosity towards equity in outdoor professions. She lives and works on Dena'ina lands in Anchorage, Alaska.

John Stimberis is the avalanche program manager for WSDOT South Central Region. He is currently working towards a Master's of Science in Engineering at the University of WA. John lives in Seattle and desperately awaits the return of live music. He is a past president of the A3.

Halsted Morris got his nickname of "Hacksaw," while he was with the Loveland Ski patrol, when one senior ski patroller couldn't seem to remember his actual name, and the nickname stuck. Hacksaw has had a long career with A3; now he serves as the A3 President.

FROM THE PRESIDENT

Gender Discrimination and Racism Should Never be Tolerated

BY HALSTED "HACKSAW" MORRIS

A major part of professionalism is that our members treat other members and the general public in an ethical and respectful manner at all times. Gender discrimination and racism are not a part of being a professional.

The A3 mission statement is:

The American Avalanche Association promotes and supports professionalism and excellence in avalanche safety, education, and research in the United States.

As I see it a major part of professionalism is that our members treat other members and the general public in an ethical and respectful manner at all times.

Our country and the world has been through a lot with the Covid-19 virus, economic downturn, and the recent civil unrest. These events have affected all of us. The murders of George Floyd and Rayshard Brooks have demonstrated that our world needs to correct how we treat each other. Gender discrimination and racism are not a part of being a professional.

Last fall A3 started the "inclusivity project" to recruit more women members before the current social events. Obviously, the inclusivity project needs to also include recruiting minority members, so this action will now be an official part of this project's focus. Down the road I would also like to see more scholarship opportunities (i.e., for pro training, attending SAWs and ISSWs) for women and minorities, which will be another way to grow our inclusivity program.

Thanks to Dan Kaveney, our executive director, A3 has weathered the economic downturn fairly well, although we still need to be conservative with our money. A3 is in a better financial position then a lot of other similar nonprofit associations. All of this is due to Dan's extremely hard work and the outstanding loyalty of our sponsors. My deep and very sincere thanks go out to all of them.

Dan and the rest of the board have been looking for ways to serve our members without spending a lot of money. You will be hearing about several of these projects, such as webinars and the new digital TAR in the coming months. If you have any suggestions please drop me an email.

I have decided to run for A3 President again. There are several things that I want to work on and finish. Getting A3 through all these "crisis times" is one of them. The inclusivity project is another program that I would like to see get solidly on its feet.

Like many of you, I have no idea what this coming winter has in store for all of us, other than the prospect that many ski areas may not function at full capacity. As a result, there may be even more people heading into the backcountry and in need of formal avalanche safety education. The Avalanche.org website lists all of the Pro and Rec course providers; please pass this tidbit along to these new backcountry riders.

I wish all of you a bountiful, peaceful, and safe winter.

VIRTUAL SNOW SCIENCE WORKSHOP OCTOBER 4–6, 2020

AND FUTURE ISSWS RESCHEDULED

BY RICH MARRIOTT, SECRETARY OF THE ISSW COMMITTEE

Like so many other things in our world the International Snow Science Workshop (ISSW) is adjusting to the current pandemic. This has required shifting the timing of future workshops. After discussion and consultation with local organizing committees, the ISSW Steering Committee has decided to reschedule the next two ISSWs in hopes that we will all return to a more normal world soon.

ISSW 2020 in Fernie, British Columbia has been postponed until October 3–8, 2021 and will continue to be called ISSW 2020 (more info at issw2020.com). However, Steve Kuijte, chair of ISSW 2020, and his local organizing committee, have made a quick change and are offering an interim Virtual ISSW (called VSSW) which will be presented live online October 4th–6th, 2020!

ISSW has been considering adding a virtual component to the Workshops in the future, but ISSW 2020 is giving the concept a full-on test. There will be 14 invited speakers, representing different nations and disciplines in the avalanche community and two panel discussions. The good news is that registration before September 28th will only be $30! More information is available at vssw2020.com (And in a separate article by Mary Clayton.)

ISSW 2022 in Bend, Oregon has been postponed until October 8–13, 2023 and will be renamed ISSW 2023. The ISSW Steering Committee decided to keep ISSW 2024 in 2024. A decision on the host site for ISSW 2024, the next European ISSW, will be made by early this fall. ISSW 2026 will be a Canadian ISSW and inquiries from interested Canadian sites are welcome. If you are interested in more information on applying to host ISSW please email isswsteering@mail.com.

Additionally, the ISSW Steering Committee website (issw.net) is undergoing an update allowing us to provide more news and information on ISSW In addition, it has summaries of earlier ISSWs and links to the ISSW publications database at Montana State University. The ISSW Steering Committee Facebook page is also online (www.facebook.com/isswsteering).

VSSW

BY MARY CLAYTON, AVALANCHE CANADA

This year has thrown plenty of curveballs at all of us, including the ISSW 2020 organizing committee. While the plans for ISSW 2021 in Fernie are still in place, we have made the exciting decision to host a virtual conference this fall on October 4–6, 2020.

VSSW 2020 will be livestreamed, with 14 international-calibre invited speakers, two panel discussions, and two interactive poster sessions—one timed optimally for a North American audience, and one timed for a European audience.

The posters will be available for viewing shortly before the start of our virtual conference, during the conference, and for a period afterwards. Delegates are encouraged to submit their work as a poster presentation. This is a great opportunity to publicize your latest research or present a new approach, and get feedback from other researchers and practitioners.

Our website at vssw2020.com will be kept up to date as speakers and the schedule are confirmed. Registration opened on September 1. The cost for the conference will be $30 and you'll want to get on that soon. After September 29, the cost will go up to $40.

Looking forward to "seeing" you all online!

In spite of the physicality of avalanches, managing avalanche hazard is primarily an exercise in understanding human decision-making.

—Jonny Hepburn

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IN MEMORIAM

MARIO RUIZ

BY DIEGO ALLOLIO

This past July 27th Mario Ruiz (50), Ski patrol Chief at Catedral Ski resort in San Carlos de Bariloche, Argentina, died after sustaining severe trauma following an avalanche which carried him into trees in an off piste zone at the resort, while conducting mitigation work with another two ski patrollers.

I had the opportunity to meet Mario while installing the very first Wireless Avalanche Beacon Training Park in South America at Catedral Alta Patagonia for which he was keen to collaborate on our effort.

In 1988 at 18 Mario started working at Catedral simply shoveling snow for shops at the base of the mountain and started to learn how to ski. A few year later he got a position as lift operator and in 1990 worked his way into his real passion, the ski patrol at Robles, when Catedral was split in two operations.

In 2004 Robles and Ladobueno joined operation to become Catedral Alta Patagonia and saw Mario gaining an important space in the new and larger ski patrol team.

Last NA season he worked at Aspen Highlands and was awarded "Best Ski Patroller" on the mountain. Mario, "the Yeti", as his co-workers called him, was always depicted by his coworkers as easy going, open to learning, and a good listener. He proved his solid problem solving skills while under constant budgetary restraints due to the ups and down in the Argentine economy. He was a back seat leader, leading by example.

In his own terms, Mario always said that after retiring he would move out of Bariloche, because being there but unable to be at the mountain on a daily basis would be too hard to endure. His early departure allowed him to live 30 years doing what he loved to do.

He is survived by his wife Carola; his three daughters Zoe, Florencia, and Naomi; and his two grandchildren, Paz and Guadalupe.

Diego Allolio is a A3 professional member, AIARE Pro Instructor who runs Aprendica Snow Safety and Magellanica Guides. He is based in Bariloche, Patagonia.

THOMAS KAVENEY

BY DAN KAVENEY

Thomas Francis Kaveney passed away on Thursday, July 9, at almost 93 years of age, after a brief illness. Tom was born in 1927 to Julia and Edward Kaveney in New Haven, Connecticut, where he spent his early years. After high school graduation he served in the US Army in Germany during the immediate aftermath of World War II. Upon completing his military service he earned a degree in Metallurgical Engineering from the Massachusetts Institute of Technology, and began a long career in the steel industry.

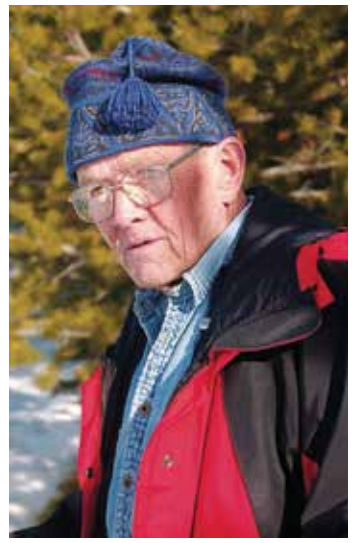
Tom lived life to the fullest, and loved all kinds of sports and activities. He was an especially enthusiastic skier, and was a devoted volunteer ski patroller with the National Ski Patrol for decades. His appetite for skiing remained undiminished as he aged, and he managed to log 60 days at Bridger Bowl during his final year of skiing at age 90! He also loved rock climbing, running, bike riding, hiking, wood carving, and playing the banjo.

At Tom's core was an extraordinary kindness and devotion to family and friends. He delighted in the activities and accomplishments of his many friends and family, particularly his granddaughters Anna and Claire. His most important and lasting legacy is the positive difference he made in so many peoples' lives. He is survived by his son, Dan, daughter in law, Marcia, and his granddaughters, Anna and Claire.

REMEMBERING ART JUDSON

November 5th, 1933–July 11, 2020

BY RON PERLA



Once upon a time there were a small number of ski mountaineers employed by the US Forest Service. They were called snow rangers. They are nearly extinct.

They arose early, almost every winter morning, and spent their day protecting the public from avalanches. They studied snow, weather, and avalanche activity, they closed and opened ski runs and highways, they tossed explosives or fired artillery to release avalanches, they issued public warnings. When all else failed and an avalanche struck, they mobilized for the rescue operation.

Art Judson, known to many of us as Jud, started as a pioneer USFS Snow Ranger at Berthoud Pass, working with legendary Dick Stillman, both trying to win a battle against Colorado's notorious deep slab avalanches. Like all the dedicated few on the front lines facing the avalanche hazard, Jud had his share of the inevitable narrow escapes. Later, he brought his real world, avalanche experiences to the USFS Experiment Station, Fort Collins, where he became a research scientist in Pete Martinelli's Alpine Snow and Avalanche Project, destined to become the USFS National Avalanche Project. Thus, Jud belonged to the highly select few who in one lifetime could call themselves research scientists and snow rangers.

Jud was a few years ahead of me in all respects. When I started a parallel career at Alta, Utah in 1966, we didn't have a large pedagogy of avalanche research to build on. We studied with great interest Jud's growing list of contributions, published in scientific journals and international conference proceedings, especially his work on the properties of alpine snow. Eventually, we performed our own Alta measurements of alpine snow properties with financial support from Pete's Project, and building upon the earlier research of Pete and Jud.

One of our main Alta problems was a road beneath a nasty group of avalanche paths. Jud took a giant step to help. He traveled to Canada to observe the avalanche forecasting and control program for the newly opened Trans Canada highway across Rogers Pass. Sections of this highway were threatened by avalanches more monstrous than the ones at Berthoud and Alta. At Rogers Pass, Jud met the patriarch of Canadian avalanche research, Noel Gardner, who innovated new methods for evaluating and controlling the Rogers Pass hazards. Jud and Noel hit it off famously. So much so that Noel felt that Jud was the unique person to collaborate with to document for posterity the successful Rogers Pass methods. Together they created a fine publication, revealing methods which found their way into our Alta road pro-

gram, into my own research, and as an important chapter in the USFS Avalanche Handbook.

Never forgetting his narrow escapes, Jud recognized at the onset of his research career that trying to out-guess avalanches involved a balance of the expected and unexpected, in short, probabilities. New statistical methods were called for, not just for Berthoud or Alta, but methods applicable west wide. The problem is that statistics require data, much more than were available from Berthoud, Alta, and a few other stations. Thus, Jud founded a Westwide avalanche data collection and information network. As prerequisite, he proposed to standardize existing snow and avalanche terminology, and to include new measurements previously ignored. These would be the inputs needed to evaluate the avalanche hazard at a growing number of stations as they came on deck to join the Westwide program.

In 1969, Jud made another trip to Canada, this time to attend the first North American avalanche conference, held at the University of Calgary. Jud presented a paper on his proposed inputs. His presentation was a tour de force. In fact, at the time it was somewhat overwhelming for the audience, as is often the case when new ideas confront a symposium audience for the first time. But in years to come, slowly and surely, his input standardization took hold.

In 1972, the USFS transferred me from Alta into Pete's Alpine Snow and Avalanche Project at Fort Collins. There I was able to witness the growing Westwide network, and to witness Jud at work, inputting data to the USFS computer, tweaking a complex, evolving model, and examining the latest computer outputs. Did they make any sense? Were there statistical patterns? Did they discriminate the expected from the unexpected? It was difficult research. Jud was open to suggestions. Ideas from others were appreciated and tested. For example, I remember one day suggesting that he experiment changing his input equation for wind direction. He tweaked his model accordingly, but output statistics did not improve. The new snow variable, inputted into Jud's avalanche model, kept on smothering the other variables. This brought up a related problem. Existing weather models did a poor job predicting the amount of new snow falling in the Colorado mountains. Jud worked closely with meteorologists at Colorado State University to develop reliable models for predicting new snow amounts.

His avalanche statistics, published in scientific journals told it the way it is: here are the statistics, here are the conclusions. Jud presented similar messages at the USFS National Avalanche schools, minus all the jargon that went into the scientific literature.

Jud and I became lifelong friends, exchanging family visits in Fort Collins. He maintained a second home in Steamboat where we once stayed to investigate a skier fatality caused by a slab avalanche near the local ski area. We climbed up to the start zone of the slab avalanche , measured snow properties just as we had done independently many years ago at Berthoud and Alta. Other times, we hiked together in the mountains, photographing snow and avalanche phenomena for the USFS Avalanche Handbook.

In 1974, I moved to Canada. We stayed in contact as the years passed on a variety of snow and avalanche problems. After all these years, I believe Jud and I still agree that avalanche forecasting is forever burdened with uncertainty. We prefer to emphasize avoiding avalanche paths, rather than gambling on statistics and probability, or counting on some gizmo to save your life.

Jud gets along well with people. He accepts people for who they are, makes the best of the working relationship. Not mentioning names, that included working with several avalanche pioneers who could be difficult in the extreme. I think they appreciated Jud's crystal clear, urbane personality, his enthusiasm for snow and avalanche work, just like them, he had worked in and survived the real world of avalanches.

BY KNOX WILLIAMS

I first met Art Judson in the spring of 1970. I was about to graduate from the Department of Atmospheric Science at Colorado State University, with my best job opportunity at the National Hurricane Center in Miami. But I wasn't sold on leaving Colorado, and that's when I learned that the US Forest Service Snow and Avalanche Research Project in Fort Collins (which I did not know existed) was looking to hire a meteorologist. So I made a cold call, and met Pete Martinelli (project leader) and Art Judson.

Jud had a vision (I quickly learned that everyone call him Jud) of establishing a data-gathering program throughout the mountainous western United States (and Alaska). This would be called the West-wide Avalanche Network. Judson and Martinelli were looking for someone (preferably a meteorologist) to set up and then manage this network of weather instrumentation. I got the job.

Jud had visited the Swiss Federal Institute for Snow and Avalanche Studies in Davos and brought home the concept of a network of avalanche forecast centers in the western US. Jud then founded the Colorado Avalanche Warning Program (CAWP) in Fort Collins in 1973. Jud was the head honcho; I was his sidekick. In the next two years, avalanche centers opened in Seattle and Salt Lake City. Central avalanche forecasting had begun in the US, with much of the data coming from weather stations to be installed as part of the Westwide Avalanche Network. These weather stations were located at ski areas and mountain highway passes in the Rockies, Cascades, and Wasatch mountains. (Today there are more than 20 avalanche forecast centers in the US.)

Jud was a good teacher. I would even call him a mentor. I wondered why he picked me for the job, especially when several people with avalanche knowledge and on-snow experience had applied. He told me his decision was easy. With the other applicants, Jud felt he would have to un-teach some false beliefs in avalanche science. With me, he could start with a blank slate and help me to get my avalanche education right. We would spend several years traveling through the Colorado mountains, observing avalanche terrain, skiing, digging snowpits, and making daily avalanche danger forecasts. I've always considered myself to have been a lucky guy with a teacher like Jud.

Jud was also one of the team that founded the National Avalanche School. That first school was held in Reno in 1973. I attended as a student.

My years of working with Jud ended in 1983, when the Colorado Avalanche Warning Program came to an end when its funding was abolished during a time of government downsizing. (The Colorado Avalanche Information Center was then founded in 1983 as a program within the Colorado State Government, and has done quite well in the last 37 years.) Jud and all his co-workers lost their jobs in 1985 when the USFS Avalanche Research Project closed.

Photos of Jud courtesy of Tom Ross of the Steamboat Pilot, used in TAR 25.3, when we documented his A3 Honorary Membership award.

Here's an event that stands out from my early, apprentice years of working with Jud. In January 1971, an avalanche near Stevens Pass, Washington, damaged or destroyed seven cabins and caught 17 residents, killing four. Jud and I flew to Seattle and spent the first day in a chartered plane to observe the entire site from starting zone to the destruction and runout zone. The following day we drove to the site to view the damage up close. It was an eye-opening education for me. That evening back in Seattle, I introduced Jud to steamed clams. (I had lived there a few years before). We were in the Seattle area for a few days, and Jud insisted on clams for dinner every night. It was a pretty good bonding experience.

BY LYNNE WOLFE, EDITOR

After I received leftover ISSW 2010 funds from Russ Johnson for the avalanche history project (still in the works, stay tuned for details), I made a "hit list" of avalanche mentors to interview: Art Judson was at the top. Summer of 2011 I went to Steamboat and spent a couple of days with Jud. As you can imagine, he was a consummate host and storyteller who quickly became a great friend. Jud gave me intros to several of his contemporaries such as Don Bachman and Ron Perla, and it was an honor to interview them and be included in their scathingly honest email chains. I am already missing Jud's insight and humor tremendously.

Take-home message: when your heroes retire, don't let them slink away into the shadows. Ask their opinions and ideas on your pressing questions; they'll appreciate being included and you'll gain from their perspectives.

BILL WILLIAMSON RECEIVES A3'S 2020 BERNIE KINGERY AWARD

July 30, 2020: Bill Williamson received A3's Bernie Kingery Award via Zoom presentation, on Liam Fitzgerald's deck, overlooking Lake Pend Oreille, near Sandpoint, ID. This was organized by Liam, with help from others. Bill was clueless. It took a few minutes for him to figure out why he could see pictures of Halsted and others, plus the word HOWIE (who couldn't get his webcam to work) plastered across the laptop screen. We all enjoyed participating in this well-deserved presentation.

Bill Williamson with his richly deserved award, which was crafted by Kiitella Designs.

Bill Williamson began his career as a Professional Ski Patroller in 1977 at Sugar Bowl, California. He had been working at the resort for a few years prior to that in various non-Patrol type jobs and living in the dorms where he earned the title of "Chief Hell-Raiser," a position for which he was without question well qualified. He worked on the Patrol at Sugar Bowl for two seasons, and then migrated to Alpine Meadows in 1978.

The avalanche program at Alpine was heavily influenced by Norm Wilson, a pioneer in the North American avalanche community; and like Norm, the Patrol at Alpine took the job of avalanche control work very seriously. Alpine Meadows is synonymous with copious amounts of snow, severe weather, and big avalanches, and working there as a Patroller is a serious undertaking. Back in the day of the original *Westwide Avalanche Network*[1], Alpine Meadows regularly topped the chart in the number of avalanche events recorded annually in the US. The now legendary March 1982 avalanche accident at Alpine was a defining moment for the U.S. avalanche community, and serves as a reminder to us all that living and working with avalanches is not to be taken lightly.

This is the environment in which Bill cut his "avalanche-teeth;" he became an integral part of one of the more complex and well-run avalanche control programs in the country.

After eighteen years on the Alpine Meadows Patrol, he took his technical skills and ability to work well with others to the State of Washington, where he had landed a job as Patrol Director at Stevens Pass, another ski area with strong avalanche control "roots." In his introductory presentation to the Patrol, he tried to highlight the differences between himself and his predecessor by suggesting that whereas the former Patrol Director had strong connections to Military Service and local Law Enforcement, Bill had been a 'roadie' for the Doobie Brothers. The Patrol seemed to appreciate this, and he was off to a good start.

After two years leading the Patrol at Stevens Pass, he was promoted to Mountain Manager. Bill successfully ran both winter and summer on-mountain operations there for the next five years.

In 2001, he returned to the Sierra, taking the position of Resort Operations Director at the ski area where he got his start, Sugar Bowl. His new job oversaw just about anything and everything that happened outside, or that was associated with skiing.

In 2005, he left California again, this time to take on the job of Operations Director at Schweitzer Mountain Resort in the Panhandle of Idaho near Sandpoint. Bringing decades of experience in ski area operations to his new job, Bill helped Schweitzer earn its rightful place amongst the rather small group of moderately sized, well run, and immensely enjoyable ski resorts in the western U.S. After thirteen successful years in that job, he retired in 2018.

Bill has made an indelible mark on the ski industry in general, and the avalanche profession in particular. He served as a Board Member with the American Avalanche Association for nearly twenty years, including a term as Vice President from 1999 to 2004. He also served on the Explosives Committee for the National Ski Area Association, helping establish procedures for explosives use in ski area avalanche control work. Many in the avalanche industry follow those procedures every day in their efforts to safely and effectively mitigate hazardous avalanche conditions throughout the western U.S.

Bill, along with Scott Savage and Ethan Greene, launched avalanchenearmiss.org, a platform that allows avalanche professionals to report their "near-misses" and to learn from others', in hopes of improving avalanche worker safety. His network of friends and associates within the ski and avalanche community is remarkable, and has allowed him to remain in the forefront of advances in ski area operations that have resulted in more efficient ways of doing much of what is required to keep the industry viable and sustainable.

We all owe a debt of gratitude to Bill for his hard work and commitment to the avalanche community for more than four decades. It seems only fitting that he receive the award named in honor of the man who hired him for the job at Alpine that propelled him forward in his career as an avalanche professional. ⬢

[1] *The Westwide Avalanche Network was a program started by the USFS in 1967 that gathered monthly summaries of weather and avalanche information from Ski Areas and other avalanche programs throughout the U.S. For more information, see article on Art Judson, pages 14–15 of this TAR.*

KPAC RECEIVES FOREST SERVICE 2019 AWARD

In fiscal year 2019, the U. S. Department of Agriculture Forest Service engaged 110,500 volunteers and service participants on projects in every region, station and area. Together, they contributed 4.8 million hours valued at $122 million and equivalent to 2,662 full time employees—nearly 10 percent of the Forest Service permanent workforce. Trail maintenance and improvements, access and collaboration are themes most prevalent in the 73 nominations submitted in five categories: Citizen Stewardship & Partnerships, Cultural Diversity, Enduring Service, Leadership and Restoration. Nominees included Forest Service employees and units, volunteers, groups and partnerships, conservation crews, and/or other participants such as interns and resource assistants. Please join us in congratulating these individuals, organizations, units and partners for their outstanding contributions to the Forest Service mission.

CITIZEN STEWARDSHIP & PARTNERSHIPS

Kachina Peaks Avalanche Center, Coconino National Forest, Southwestern Region

The Kachina Peaks Avalanche Center (KPAC) provides avalanche education, safety training, and snowpack information for San Francisco Peak and Kachina Peaks Wilderness of Northern Arizona. A 501c3 non-profit organization, KPAC is operated primarily with volunteers as a special uses permittee. KPAC is integral to the Coconino National Forest's ability to ensure the safety and wellbeing of the 5,700 visitors to Kachina Peaks annually and residents in the surrounding communities. Faced with record snowfall in 2019—the fourth wettest winter in the last two decades—KPAC provided a weekly avalanche and snowpack summary to a record 4,718 visitors to their website. KPAC takes its role as an educator very seriously. They offer a Level 1 avalanche class and provide scholarships to help offset costs for participants, and they work hand in hand with the local community to present free avalanche workshops each winter hosted at various gear shops, festivals, and municipal buildings throughout Flagstaff. KPAC exemplifies the core Forest Service values of safety, service, conservation and interdependence. ⬢

PREPPING FOR A PRO COURSE

INTRODUCTION AND COMMENTS BY KATE KOONS, ARTICLE BY BILL MARK

This coming winter marks the fourth winter of running pro courses. If you are already in the industry or aspiring to be, you have probably either taken a course or are planning to do so. If you are anything like me, taking a professional level course with multiple assessment components makes me instantly start hyperventilating. Years ago, when I took my Level 3 course, I failed my rescue exam the first time through. Before the exam's start, nervous and anxious, I had sweated through my base layers (it was in the teens). The reality was that I had not practiced enough. So I flailed. Lucky for me, I had a second chance. I asked to not have folks watch me, I took a break in between other testers and came back and did just fine. If I could do it all over again, I would have practiced way more than I thought I needed to. I spent lots of time digging pits because this is what I thought I needed to do. Yet the reality is rescue is the one thing we need to be able to pull out of our toolkit when we least expect and we better nail it.

Many students and aspiring students want to know what they can do to prepare for a pro course. Pro courses are demanding, expensive, and at times can feel stressful. And they are also fun! Both as a teacher and a student, I always enjoy meeting people from all over and learning from everyone. Education is one of the best ways to prepare for any eventuality, and as an avalanche professional, we juggle lots of variables, so taking a pro course is a worthwhile investment.

Bill Mark wrote the following article for the CAA Avalanche Journal years ago and agreed to let us use it here; it is just as pertinent today as it was back then. I've also asked the A3 Pro Course Providers to chime in with some advice on how best to prepare. Bill's original text is black; my additions are purple.

BE PREPARED: THE 6 PS

Prior Planning Prevents Piss Poor Performance.
Be prepared, practice and train, well ahead of the course.

We have all likely heard this before. It is an old adage from the British Army. Also known as the 5 Ps, 6 Ps, or 7 Ps. Moral of the story, planning ahead rarely is a bad idea.

Sean Zimmerman-Wall, Pro Course Director of AIARE says "Take care of personal logistics early. Taking a professional level course also means taking your planning to the next level. If you are traveling several states away, consider things like lodging and meals. Beyond the additional costs of these items, there is the mental load and physical duress that comes with scrambling to eat every night or waking up in the back of your truck when it is -10F. Consider sharing resources with other students through meal prep, carpooling, and accommodations. Having a place to study and sleep every night is essential during one of these intensive courses. You may also look to see if a course is being offered out of a lodge/hut and includes a meal plan. While this adds upfront cost, the payoff during the course is huge. Anything you can do to increase your mental bandwidth is well worth the investment."

GET A TRAINING BUDDY AND MAKE A REGULAR SCHEDULE.

Ideally it's someone who's going to the same course so there's some additional motivation. It might be someone who's training for a lower or higher level course, that's OK too as the sharing of information will help. Often more experienced folks like to participate and assist, see mentorship below.

Make sure you are training on the right things, to the right standard for the course you are about to take (see below).

You may be lucky enough to take a course with a friend or colleague so they can be a perfect partner with whom to train. Or, go out with a friend and have them challenge you during rescue practice or in new terrain.

STANDARDS AND SYSTEMS: WHEN IN ROME…

Find out exactly what is required, standards and course objectives. Start with the A3 website: www.americanavalancheassociation.org/pro-training-program. Talk to someone who has just taken (and ideally passed) the course. Talk to a current instructor (one who has worked in the last 12 months). Find out who you need to talk to ensure you are training to the correct standard and methods or techniques for that course. (Also see Hire a Pro below.)

Certain organizations have certain standard ways (techniques) of doing things. Be it the CAA, CSGA or ACMG, find out and learn the standard systems and techniques the organization conducting the course uses. Practice and perform this method so you can do it in your sleep, then perform during the course and most importantly on the exam. This is especially relevant for hard skills such as rope systems.

Even the best prepared person might get corrected or shown a different way by an instructor when you perform the skill on the course in a non exam setting. Don't be defensive or make excuses, you've been given a gift on how you can pass the course (shut up and listen). Listen, observe and make that correction when you perform the skill next time. Yes, I know *your* way might be a way better tool, you might be quicker or more efficient, but do it the way the organization and instructors want it done, then you will increase the chance you'll pass. If you really hate the method so much, once you've passed the course you can volunteer to be on the standards or technical committee then you can contribute to the change! Often if we think about it the different methods achieve the same goal, but on a course, do what the examiner wants, it'll help you pass. Examiners want you to pass.

Pro courses are intense, and they are wonderful learning opportunities. The most effective teachers are the ones that keep on learning. **Sarah Carpenter**, of the American Avalanche Institute agrees, saying "Courses

should also be learning opportunities. Remember this. You are not always being tested so clarify testing times vs. pure learning times."

GET A MENTOR EARLY

If you know you are going on a course, find someone (or a few folks) that you can talk to. It is worth finding someone you can share your mistakes and be able to open up to. You may want to consult a more experienced person, who may be available to debrief your day of work in the mountains from time to time especially after significant events.

Don't wait until the month before the course, start the season before. Mentors are a great way to become a better mountain professional and to successfully pass courses. Experience has shown those who find experienced mentors often perform better at courses (and make better decisions). You may have a number of mentors on different topics. They can be at your workplace, in your hometown, or on the phone. Try using your spouse as a sounding board.

This not only pertains to pro courses. We could all do with having mentors in our life for a variety of reasons. Seek out someone you respect and like, but also someone that can challenge you. Often our best mentors are the ones that push us to our finest and most effective learning edges.

PERSONAL REFLECTION

Take the opportunity to look at your work day in the mountains and reflect on what you did well today and what might you have been able to do better? For some, making notes helps. During the CAA L2 Module 1 program, students are urged to use learning journals, this works for some and not others. The key is to think and learn on a daily basis. Debrief your day with others (See Get a mentor early above.)

Jim Donovan, Director of Silverton Avalanche School, encourages all students to identify your weakness and then train to that. "Maybe you don't dig a lot of pits, or maybe your note taking is lacking. Identify these early on and practice well before your course."

TRAIN ON THE HARD SKILLS

On an exam there are often rote skills you will need to perform to a standard, e.g. transceiver tests, snow observations (profiles), crevasse or rope rescue skill demonstrations. You should make time to practice and to be excellent at these hard skills before the course starts. Then, when exam time comes around it will be low stress and easier to pass these "hard skills."

This means that when you are at the course you can spend your valuable time and energy on learning, watching and refining the "soft skills" like mountain travel and awareness. You now have the ability to demonstrate and perform at your best for the other more-difficult-to-demonstrate skills such as the elusive "mountain sense."

There is nothing more frustrating for you (and the instructor team) to see someone flailing on a transceiver exam with a new device that has not been practiced adequately. (See notes on knowing your equipment below.)

While I'm on the subject of mountain sense, I have some thoughts on this age-old question for both candidates and instructors: How can you demonstrate "mountain sense" as a student, and how can you mark it as an instructor? It's my opinion that you can go some way towards learning it through mentorship and experience, but I strongly believe that it's in a similar vein to music, you can teach anyone to play the guitar but you need the innate ability in the first place to be really good at it no matter how hard you might practice or be coached.

All Pro Course Providers agree that practice makes perfect, or at least close enough. Having worked multiple Pro courses, it is obvious who has practiced their rescue skills and who has not. Those who have practiced have a strategy and they stick to what they have practiced. Those who have not practiced are slow, inefficient, and lack a plan. Don't be like me, practice until you can find those two beacons (and bring them to the surface) in well under 7 minutes.

Melis Coady, Director of Alaska Avalanche School, says "Practice your transceiver search multiple times, noting each time what you can improve. This should include physical items such as making your transceiver easier to access or developing a framework for when to remove your skis or pacing, breathing, and timing issues. Find your problems and fix them before you test."

KNOW YOUR EQUIPMENT

If you know you are going on a course, look at all your gear: from skis, bindings and skins, snow safety gear, shovel, probe and transceiver, rescue equipment (improvised toboggans, rope rescue gear). Does anything look close to being worn out, do you have any pieces missing, does anything need replacing before the course? If so, replace it and use the equipment well before the course begins. Break in those new touring boots well before the course.

Maybe you're one of those people who is always prepared and you check your gear after each tour. That person would not be me, but before I show up to work or take a course, I take inventory of my gear and ensure it to be in working order. I'll often bring back ups and a repair kit. During my Level 3 we were all booting and suiting in the parking lot getting ready for a long tour and one of the instructors was walking around asking if anyone had an extra pair of skins. In my mind, all I could say was... thank god it was not me. Turns out it was one of the other instructors who is a beast of a man. So like any good mountain man, he cut down some pine boughs, collected some ski straps and strapped those boughs to his skis. I continued to thank some higher power all day as I tried to keep up with him that it was not me!

TAKE A TRIP

Where is the exam being conducted? Is it in your back yard? Is it in a different snowpack and climate zone? No matter where the course is, it's always good to take a trip away to train in other areas to broaden your experience. Travel in terrain and snowpacks you are not familiar with.

Arrive a few days early near the course venue so you can find out from the locals

about the weather, snow and terrain as well as get a day or two in the field to look for yourself.

One of the coolest part about becoming more prepared through education and training is to travel outside your home range. **Jim Donovan**, from SAS, says "Know the venue. It can be very helpful to go to a new zone that you are not familiar with. Do some research on the area, snow climate and the types of avalanche problems you may encounter. Bookmark and read the forecast daily prior to the course to understand trends you will encounter."

HIRE A PRO FOR A DAY

If you don't have the benefit of training buddies or mentors close by, take a trip and hire an instructor from the program you are taking to get honed up a month or two before the course. If you know some others taking the course get a group together to reduce cost. Have a list of questions that you want answered so you get the best value for your day out. This is by no means an exhaustive list, just a few ideas, but above all…

You might be thinking "hire a guide in addition to paying for a Pro course??" While it is an investment it could be a well worth one! **Jim Donovan**, SAS, shares, "When you hire an instructor or a guide, it can be more straightforward. Make sure you know what you need to work on to maximize your time."

BE PREPARED, TRAIN, AND PRACTICE

This is the personal opinion of the author and not of any organization such as the CAA or CSGA

All educators agree that if you do these three things you will set yourself up for success. **Melis Coady** says that the last piece of advice is to relax. You've been doing this stuff for a while now. Once the course begins, "drive it like you own it."

I'll add a few more bullets to Bill's article:

- In this day and age, technology is a part of the avalanche world whether we like it or not. Having a computer or tablet will make your pro course much easier. You will be asked to fill out am/pm forms online, read the forecast daily, and enter your snow pit data into Snow Pilot. Bookmark pertinent weather and avalanche sites prior to showing up for the course and have familiarity with them.
- Solid systems make your work consistent and less stressful. Do your pits the same way each time. This will save you necessary time and headache.
- Most importantly, remember self care. Most of us mountain people have an amazing capacity to absolutely thrive when doing the things we love, and often self care gets thrown to the wind. It's easy to get fried. Being able to recharge at the end of the day will allow you to engage better each day. And drink water!

Bill's advice rings true for any sort of exam or assessment-based course, of which there are more as many industries, not just ours, move towards more necessary certifications. For the avalanche industry, we have seen many benefits through implementation of the A3 Pro program. Before the pro-rec split, avalanche education was siloed to its specific sector of the industry. Today you can expect to be in a room full of professionals and aspiring professionals from a variety of jobs within the avalanche world. I have learned so much from colleagues who are forecasters and patrollers, and hope that I have been able to offer them something as an educator and guide.

As we move into the fourth winter of this standardized educational approach, we are continuing to create a shared language as well as shared expectations of one another. While we will always have specifics that we need to train to and learn for our jobs, our basic training should have base consistencies.

As we all navigate through this uncertain time of Covid, perhaps you'll find some more time for preparation, goal setting, and self reflection before the winter is upon us.

As for me, I'll be moving on from my job as the A3 Pro Training Coordinator, which I began (as the third individual to hold this post) in December 2017, the first month we ran pro courses. It's been a fascinating three years of working with smart, engaged, and passionate individuals, and has been a great learning opportunity to help manage a program that has brought a lot of challenging change to our industry. Challenging because, let's admit it, humans don't like change initially. Yet I think this has been a great move and am excited to see the program grow in years to come. I'm moving on to work for the US Antarctic Program as their Field Risk Manager, overseeing field risk and response for scientific research. I'll still manage to squeeze in an avalanche course here and there, so I'll be seeing you around. ⬢

Kate Koons is a lifelong learner who will be the first to laugh at herself. She will be leaving her job at A3 this fall, yet she won't be far from the avalanche world. She'll continue to teach pro courses and ski guide when she can fit them in. More than likely, you'll bump into her somewhere in the Tetons on her skis or trail running.

Bill Mark has been working in the winter sports business for almost his entire career, beginning as a ski patroller in the mid 80's in New Zealand. He was the Ski Patrol Director on Blackcomb Mountain for the last 7 years of the last century, then moved to Mike Wiegele Helicopter Skiing where he is now a Senior Lead Guide. He continues to take, teach and examine ski industry courses. Since the mid 90s he has been instructing for the Canadian Avalanche Association (CAA) Industry Training Program and teaching and examining courses for the Canadian Ski Guide Association (CSGA). He holds the CAA L3 and the CSGA L3 and Ski Touring module certificates and is an ISIA certified ski instructor.

PRACTICING THE TALK, NOT JUST THE WALK

BY ERIC HASKELL

Editor's note: Eric sent in this article and I then passed it around to some folks in our avalanche community who think a lot about how to teach and improve communication: Ken Wylie, Doug Krause, and Laura Maguire.

Half the world is composed of people who have something to say and can't, and the other half who have nothing to say and keep on saying it .

—Robert Frost

Interesting stuff.

Yes, communicating the facts without attaching our hopes, dreams and biases is the challenge. The problem is that we do. The guiding industry is under pressure to please the clients. The human tendency, especially with less seasoned people (And seasoning takes profound near miss events or tragic ones and learning from them) is to communicate poorly because we are estranged from consequence.

If you had one day to live what would you do? This question almost always changes our priorities for the better. This is the entry point for a healthy truth about risk communication. When we include the fact that what we are doing in the mountains might actually kill us, the conversation changes. It impels us to take courageous action: To communicate effectively. To own up to a mistake. To see our decisions as a choice instead of a sacrifice. To take transformational steps with ourselves and those we travel with. Courageous action. Backcountry skiers put themselves and their companions in situations that are life threatening nearly every day. Mortality meditation sparks precise and caring actions. When we operate from a position of truth about our frailty, we make our best possible choices because we can see the hazards in honest ways as opposed to pretending they are no big deal.

Further, there are a number of other practices that help us underpin good communication.

Haskell nails the notion that we do not practice communication. We need to. I developed the course "Heroic Adventurer" to help with this. Good communication often requires that we are heroic. It demands that we speak the truth in a world that has become enslaved by consumption of adventure events.

—Ken Wylie
IFMGA
Author of Buried

Communication breakdown is commonly noted as an important culprit in avalanche accidents. Curiously, we spend little time practicing this skill. Crew resource management has helped us create checklists; however, we still have a ways to improve in this facet of the avalanche problem.

Putting thoughts into words and having others understand exactly what you are trying to convey can be a hard to impossible task. Even when it is easy we often fail. Sharing our observations, our risk assessment, and our plan is something that should flow seamlessly and continuously as professionals, yet it is something that most of us could be better at. Recreationalists should also be taught to communicate well. The basics of how to do this are well known yet can get skipped in the field. Awareness of these challenges is not enough; we need to build them into our daily ritual. Practice makes habit and what follows are some tools to practice this season during staff-trainings and avalanche courses.

These simple and effective tools were developed by the military. They have been adopted in healthcare and emergency services to avoid errors in dynamic high-risk environments where communication is critical—sounds familiar? Research has shown the use of these tools results in higher team performance and a dramatic decrease in patient errors in healthcare. They are easy to use and ensure all of the important information is conveyed. Two of these tools are SBAR and closed loop communication.

SBAR is an acronym that creates a template for organizing our thoughts and conveying them to our team without missing critical components.

Situation—What was observed? What is happening?
Background—What is the context?
Assessment—What is the relevance? How does this speak to stability? Or to the situation?
Recommendation—What are we going to do about it?

In addition to SBAR, closed loop communication creates a circuit that ensures our message has been transmitted without error. It involves call-outs and check-backs. A call-out is a message that is directed to a specific individual for whom the message is relevant, or to the team, and calls for a response. The check-back allows both parties to ensure the correct message has been conveyed and allots the receiver an opportunity to give feedback or ask questions.

For example, a lead guide shares conditions at morning meeting:

Call out: "Hand shears and test slopes are consistently showing clean, easy results on a surface hoar layer 30cm down. This seems to be at the interface of the last storm. Skier triggered slides will be easy to trigger and small to large in size from this layer. Let's close Two Pitch and Poker Face and use caution on the small terrain features on Rolly Bowl."

Check back: "The surface hoar you found 30 cm down is producing clean, easy results that may produce easily triggered small to large avalanches. You want to close Two Pitch and Poker Face and exercise caution on Rolly Bowl. What about Ricki's?"

These concepts are easy enough in theory but require practice to become habit. Here are three exercises to do that. They are intended for use during preseason ski patrol and mountain guide trainings, as well as in recreational and professional avalanche courses throughout the season. The level of challenge can be adjusted for different audiences.

EXERCISE 1: RELAY RECALL

Divide group into teams of four or more.

The first team member has one minute to read statement A and then must whisper, from memory, to participant # 2. #2 tells #3, #3 tells #4. At the end check for accuracy.

Round two, the group uses call backs at each transmission before telling the next participant statement B. Compare the results. Discuss what other techniques would aid in accuracy such as a field book. Were the most important components of the message conveyed or lost in the details?

Statement A: "At 9700' on an NE slope I found fist hard 1-2mm facets 87cm down, sandwiched between a pencil hard crust and 1 finger facets. The layer was reactive with moderate, sudden planar CT and ECTP21. This is the layer that failed on Mount Diamond's east face yesterday, HS-N-R3-D3."

Statement B: "Yesterday, two slides were observed on the west side of Buck's Drainage. They were SS-AM-R2-D2 and SS-AS-R1-D1.5. Both slides failed on 6mm surface hoar buried 42 cm deep. If tonight's forecast of 16 inches comes to fruition, this could step down to the widespread 3mm depth hoar layer that has been lingering since Oct. 28th."

EXERCISE 2: OBSERVATIONS AND DECISION-MAKING

Divide group into small groups of four to five. Each group is provided with a map of the terrain they will be "traveling" through with four routes on it and a set of cards (enough for each participant to have five to six cards.) All routes travel through avalanche terrain—complexity of terrain should be matched with appropriate challenge of group. On each card is a clue pertaining to parts of the avalanche forecast, weather forecast, recent field observations, group equipment and team components (such as who is part of the team and who is hung over.) Conditions should coincide with a moderate hazard rating with weather pushing to considerable as the team is in the field.

The cards will be evenly distributed. Each participant can silently read their cards and only their cards. After being briefed of the situation and reading their cards, the participants will have 15 minutes to discuss the routes and rank them from least hazardous to most hazardous based on current conditions. Participants cannot read from their cards; they can only share the clues from memory. While the group is sharing their clues a PowerPoint will be playing in the background with additional clues—updated weather forecast, updated field observations from the group as they travel through terrain and photos of observations they would see.

At the end of the session, compare rankings of the different groups and discuss the correct answer, checking to see if any clues were missed. Discuss

how clues are missed while in the real world, especially due to communication breakdown.

EXERCISE 3: PRACTICING CONVERSATIONS ABOUT RISK ASSESSMENT

The goal of this exercise is to build the habit of discussing risk into our practice and work on communication skills, not hazard assessment. Aim to get lots of repetition in as opposed to drawing out discussions. Clearly discussion is important and takes time, but this exercise is more geared to building a foundational process for effective communication. Our goal is to build a ritual.

In the field, find a slope that can be broken down into numerous pitches. The terrain and snowpack should be of acceptable risk prior to exercise. Descend the slope, stopping and having a discussion atop each pitch. Alternate leaders at the top of each pitch. Leader facilitates discussion:

1. **Is this slope capable of avalanching?** Based on slope angle and slab characteristics
2. **What would an avalanche look like on this slope?** Boundaries? Runout?
3. **What would be the consequences of being in an avalanche on this slope?** Size of avalanche? Terrain traps?
4. **What is the likelihood of an avalanche?** Relate avalanche problem, sensitivity, and slope characteristics to individual slope
5. **How confident are we in our assessment?** How much uncertainty is in the mix?
6. **What are we going to do about it?** Alternatives? Risk tolerance? Margin of error? Spotter location? Regroup location? Travel techniques? Group consensus?
7. **Enact Plan**

ADDENDUM: TIPS FOR ADAPTING TO COVID-FRIENDLY CLASSROOMS SESSIONS

Exercise 1: Preassign groups and the order of participants. Using Zoom, create as many break out rooms as there are participants. Split into rooms. Start the chain off by going into the first participant's room and reading the statement to them. Then move that participant to the next participants room and so on and so forth. Come back together for group analysis.

Exercise 2: Utilize breakout rooms to split groups. Email one person from each group premade PowerPoint with updated conditions. Have them share their screen and play PowerPoint while the group shares clues and discusses hazard comparison of routes. Come back together for large group comparison and discussion.

Exercise 3: While this exercise is best utilized as an in-field exercise, it can also be utilized by sharing both a photo of each pitch and a topographical map with class, and alternating who leads the discussion. ⬢

FURTHER READING

Müller M, Jürgens J, Redaèlli M, Klingberg K, Hautz WE, Stock S. Impact of the communication and patient hand-off tool SBAR on patient safety: a systematic review. BMJ Open. 2018;8(8):e022202.

Salik I, Ashurst JV. Closed Loop Communication Training in Medical Simulation. In: StatPearls. StatPearls Publishing; 2020.

Eric Haskell is a former guide who is currently studying to be a Physician Assistant. He continues to teach avalanche courses to the communities that he loves.

Good to see this issue getting more attention. I've seen some prioritization of comms in avalanche curricula in recent years, but I think the way it's handled is probably all over the place depending on the provider. Go figure. It's tough to peer inside the adamantine bubbles that most operations cultivate, though my spidey sense agrees with Eric that the subject is more often than not overlooked or given short shrift.

The provision of tools for practicing communication and highlighting challenges is a useful first step. Moving forward, I believe instructors and supervisors need to be more proactive in providing feedback on team comms. You can't force someone to accept feedback, but failing to provide it is a leadership failure. Relying on independent or seasonal practice won't get us very far.

My current soapbox is ***listening***. Mighty common for communication training to skip half the subject. Communication is a team effort and the listener's responsibilities are equal to the speakers. Targeting listening may be even more important because poor speaking is usually rather obvious, but poor listening is a persistent weak layer that can go undetected for a lifetime.

Issues of confirmation are (in theory) easily resolved. As Eric notes, one can repeat information to confirm that it was heard correctly, or go deeper and rephrase and repeat information to ensure that full meaning and intent are correctly understood. More insidious are distraction and filtration issues.

We are not capable of effective listening while simultaneously performing another task. Period. Our pre-frontal cortex is like a single-threaded CPU that can switch rapidly between tasks, but not perform multiple independent tasks simultaneously. If you try, you are disrespecting the speaker and compromising the message. So, speakers must respect potential listeners attention resources by assessing or confirming their readiness to listen, and effective listeners must prioritize receiving the message by fully dedicating their attention.

Most corrupting of all are the affective filters applied to the messages we receive. If I am angry, or stressed, or tired, etc.—these filters influence the way I interpret a message, regardless of its intent or content. A speaker may deliberately or unintentionally trigger one of these emotional states. Listeners are quite capable of self-triggering. "Every message passes through two filters: the speakers ability to express, and the listeners ability to hear what was said." (Michael Nichols, *The Lost Art of Listening*)

A wise old man once opined "**In communication, as life, mastery of oneself is the first step on the path towards truth.**" (Krause, TAR 32.2.)

—Doug Krause

Overall, I think it is a well written article, it seems to hit the mark for the audience being clear and concise.

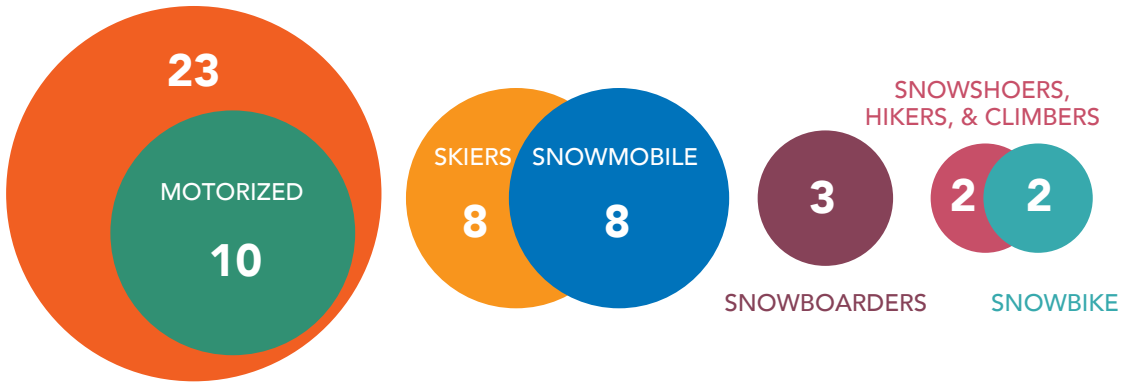
- Love the opening quote!
- "The basics of how to do this are well known yet can get skipped in the field." To me, we as researchers, educators and safety-oriented folks have an inherent responsibility to interrogate these kinds of statements more because the big question (that should be **studied not opined on**) should be *why?* There are a number of papers that make these kinds of claims but never go any further to explore why and how this happens and under what conditions is it more or less likely to happen? The more we know about this the more specific we can be in our guidance.
- "They have been adopted in healthcare and emergency services to avoid errors in dynamic high-risk environments... closed loop communication creates a circuit that ensures our message has been transmitted without error. It involves call-outs and check-backs" and, less dramatically, at Starbucks where multiple, simultaneous activities are underway concurrently and the confirmation serves to orient the barista to incoming orders. (I'm being totally serious here, it's a useful practice!)
- I think the example given is solid for helping the reader be clear about what is being proposed but, I'd add a line about the context. "For example, two av techs at a ski resort discussing the morning patrol might use the following call out/check back:"
- I might suggest making the example a bit less clinical and more conversational. Call out was good but the callback could be "The surface hoar you found 30cm down is producing clean, easy results that might make easily triggered small to large slides. You want to close Two Pitch and Poker Face and exercise caution on Rolly Bowl. What about Ricki's?"
- Also, in the example given it seems the check back is adding a suggestion to discuss Ricki's (a different run?) but that's not clear without providing the context or a follow up statement to orient the reader, as in "In the callback the tech also suggested another slope he considered might also be subject to the same danger"
- I like the idea of some exercises but you might want to say who they are for/ context when they might be used (in pre-season training? in class curriculum for rec avy courses? Around the firepit at fall bbq's or at the trailhead for established touring groups wanting to introduce the technique?
- I love the Covid adaptations
- Of course, as a researcher I'm always curious on references. Any time I see a line of "Research has shown" I want to know the sources. I think there are more than a few folks who would be interested in following up so maybe a citation or a "further reading" at the end could sate that curiosity.

—Laura Maguire

U.S. MOTORIZED AVALANCHE FATALITIES 2019–2020

COMPILED BY MIKE DUFFY

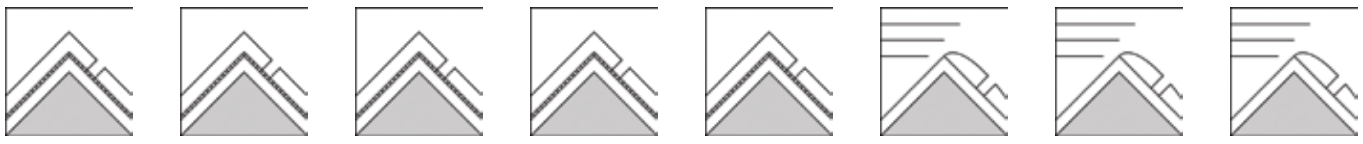
TOTAL U.S. AVALANCHE FATALITIES



AVALANCHE FATALITIES BY STATE

AVALANCHE DANGER RATING AT TIME OF ACCIDENT

TYPE OF AVALANCHE PROBLEM AT TIME OF ACCIDENT



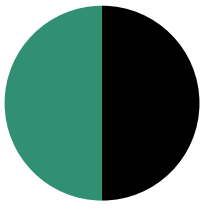
ACCIDENTS WITH MULTIPLE RIDERS CAUGHT

ACCIDENTS WITH MULTIPLE COMPLETE BURIALS

ACCIDENTS WHERE MEMBERS ADMITTED THEY DID NOT CHECK FORECAST

AGES OF VICTIMS (ALL MALE):

18, 21, 24, 26, 28, 30, 32, 33, 46, 50



50% UNDER 30

NUMBER OF VICTIMS WITH AIRBAGS

NUMBER OF VICTIMS WHO HAD AIRBAGS BUT DID NOT DEPLOY

NUMBER OF VICTIMS WITHOUT A TRANSCEIVER OR WITH IT TURNED OFF

RECOVERY TIME (HOURS:MINUTES) AND BURIAL DEPTH

No Transceiver (2 burials)
- 2:00—7.5′
- 1:15—6′

Transceiver Off (1 burial)
- 2:30—4′

Transceiver On (6 burials)
- 0:30—5.5′
- 0:45—3′
- 0:40—3′
- 0:50—6′,
- 2:00—10′
- 5:00—12′

SUGGESTIONS FOR EDUCATING MOTORIZED USERS

JUST MY .02

BY MIKE DUFFY, AVALANCHE1.COM

Some problems I'm seeing from these accidents, interviewing survivors, educating riders and witnessing riding groups:

- Riders are not doing thorough transceiver checks before heading out.
- Riders are acting as individuals who ride in a group. They are not acting as a team with accountability for members. Initiative is not being made to effectively check gear and discuss terrain options.
- Rescue skills are lacking.
- Many riders are choosing not to take on-snow avalanche classes (Level I or greater)
- Some riders are still not wearing transceivers and many riders are not proficient with them.
- Riders are buying airbags in lieu of advanced avalanche training. A very large number of nondeployments. Many feel it is intuitive to grab a trigger handle during an avalanche and feel the airbag will allow them to survive any situation.
- Riders do not understand how to manage terrain according to the avalanche problem(s).

THE GOOD: Awareness classes have made a significant impact in reducing fatalities among motorized users. More riders than ever are taking on-snow advanced avalanche classes.

THE BAD: The current number one common factor in fatalities with motorized users is lack of advanced on snow training (level I or greater).

It is hard to change habits of people who have been riding for 20+ years. Also difficult for someone in those groups to implement change. Riders new to the sport have easy access to high consequence terrain and many choose not to be trained.

SUGGESTIONS FOR TEACHING MOTORIZED USERS:

1. Don't dumb it down. These riders cover more terrain and make more decisions in a day than human powered users. They are exposed to significant terrain decisions on all aspects and elevations. They need more knowledge than other user groups, not less. This may be your one chance to train them.
2. Teach multiple burial transceiver skills. Multiple complete burial accidents happen with motorized users in difficult terrain. You're not doing anyone a favor by only doing single burial transceiver drills on flat terrain.
3. Emphasize full transceiver tests at the beginning of the day. The process used in this link eliminates many of the problems and everyone gets daily practice with their transceiver. YouTube: "Avalanche Transceiver Trailhead Test for Snowmobilers" by BCA.
4. Too many accidents are happening with persistent weak layers. Riders need to understand how to manage these problems, communicate with the riding group, and discuss options.
5. Show multiple stability tests on different aspects and elevation.
6. Get into avalanche terrain and show students how you are analyzing terrain/stability.
7. Rescues are taking way too long. Have students practice deep burial digging techniques.
8. Get the point across to choose your partners wisely. No training, no go. Those without training are a liability. Speak up if bad decisions are being made.
9. Training is not a one and done commitment. Encourage practice, annual learning, and implementation of new skills within riding groups.

This photo was taken the day after a double snowbike fatality on February 15, 2020, in the South Fork of Dickson Creek, east of Red and White Mountains, Vail–Summit County zone, Colorado. *Photo Mike Duffy*

Mike Duffy is Director and Lead Instructor at Avalanche1. He travels annually across the country presenting sled-specific avalanche safety training at snowmobile dealer and club locations.

COMPARING EXTENDED COLUMN TEST RESULTS TO SIGNS OF INSTABILITY IN THE SURROUNDING SLOPES

Exploring a large international data set

BY FRANK TECHEL, KARL BIRKELAND, DOUG CHABOT, JIM EARL, IVAN MONER, RON SIMENHOIS

Since its introduction in 2006, the Extended Column Test (ECT) has become one of the most popular tests to assess point snow instability. In 2009, two studies explored how ECT results correlated to observed instabilities, laying the foundation for the tests' interpretation we are using today. Based on data from the first winters, Ron Simenhois and Karl Birkeland showed that ECTVs and ECTPs were typically observed when conditions indicated instability, while ECTNs and ECTXs were mostly observed on stable slopes (for ECT scoring abbreviations refer to observational guidelines [Greene et al., 2010]). This continues to be the standard for interpreting ECTs in the United States. In Switzerland, Kurt Winkler and Jürg Schweizer noted that ECTP≤21 detected a large proportion of unstable slopes correctly while keeping the number of false alarms low. Again, ECTNs or ECTXs were more frequently associated with stable slopes in their study. In Switzerland, this is the operationally used approach to classify ECT results.

Now, more than ten years later, the ECT is a well-established test internationally. The time is right to revisit these stability interpretations, as recently done using Swiss data (Techel et al., 2020), by combining ECTs from North America (mostly from the U.S.), Spain, and Switzerland.

WHAT DATA DID WE USE?

We explored several snow profile databases from snowpilot.org,Val d'Aran (Spain) and Switzerland. We only included backcountry snowpit profiles with ECT results and information about the presence or absence of clear signs of instability. In total, we had:

- 2,579 ECTs from snowpilot.org, with about 90% from U.S. (snowpilot.org is open to the public)
- 167 ECTs from Val d'Aran / Spain, with profiles mostly collected by forecasters and observers
- 1,226 ECTs from Switzerland, with profiles observed by researchers and field observers

These ECTs are therefore just a small subset of the more than 30,000 combined ECTs in these databases.

HOW DID WE ANALYZE THE DATA?

For each ECT, if more than one failure was indicated we used the following rules to decide which result was the most relevant for stability assessment:

1. If an ECTV or ECTP failure was recorded: we considered the lowest number of taps required for full propagation.
2. If full propagation was not observed, we considered the lowest number of taps associated with the ECTN or ECTX.

If there were several ECT results in the same snow pit, we randomly picked one. This provided us with a dataset of almost 4,000 ECT results.

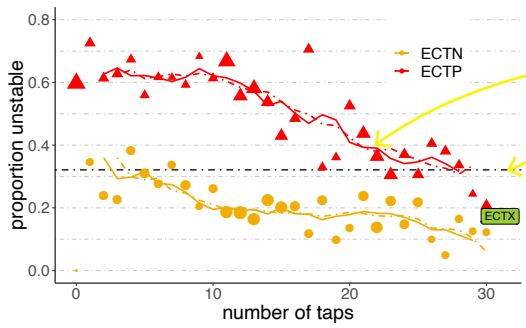


Figure 1: Proportion of unstable ECT locations for each combination of fracture propagation and number of taps until failure. The larger the symbols, the more data points. The respective colored lines represent a running average, calculated over five consecutive number of taps. The black dashed line represents the base rate, the proportion of unstable locations in the data set. ECTP (red triangles) were observed more often in unstable locations (above the black dashed line), ECTN (yellow circles), and ECTX in stable locations. The proportion of unstable locations for ECTP>22 and ECTN≤8 neither truly indicated unstable or stable conditions.

We classified the stability of each ECT location by relying on observed signs of instability in its surroundings.

We considered ECT locations to be unstable when signs of instability (such as cracking or collapsing) or recent avalanches were observed in surrounding slopes. If observers clearly stated that neither signs of instability nor recent avalanches were present, or if they indicated that the slope in question was skied or snowmobiled (in the U.S.), we considered these locations to be stable. In our dataset 32% of the ECT locations were classified as unstable and 68% as stable. These are our base rates, and we will compare the results of the tests to these base rates.

For those of you interested in a little more information on our analyses, read this paragraph. If you are not interested, feel free to skip to the next section.

For a more scientific and detailed description, we refer you to Techel et al. (2020). In short, for each combination of ECT results (whether or not it propagated and the number of taps), we calculated the proportion of tests associated with observations of instability. To smooth the scatter in our results, we calculated a running mean of the proportion of unstable observations for five consecutive numbers of taps. We then asked: Is the proportion of unstable slopes of a specific ECT result (propagation and number of taps) significantly higher (or lower) than our base rate (0.32)? If the proportion unstable was higher than the base rate, the respective ECT result (propagation and number of taps) was clearly observed more often in unstable locations, confirming this result was more commonly associated with unstable conditions. If the proportion unstable was lower than the base rate (0.32) then those results correlated more often with stable conditions. Values that were not significantly different from the base rate were interpreted as neither truly unstable nor stable.

WHAT DID WE FIND?

Quite clearly, ECTVs and ECTPs are observed more often on unstable slopes (red line in Figure 1 located above the base rate, represented by the dashed black line), while ECTNs and ECTXs are observed more commonly on stable slopes (yellow line located below the base rate) (*Figure 1*). **Further, ECTs with a higher number of taps tend to be more stable. ECTPs with less than 14 taps were the most unstable, with about 60% of those tests being associated with avalanches or signs of instability.** This is about double the number of locations associated with avalanches or signs of instability in our entire dataset (the base rate). While still clearly on the unstable side of the base rate, the proportion of unstable locations decreases with more taps, even with an ECTP result. When more than 22 taps are necessary to initiate a fracture in an ECTP, the proportion of unstable slopes was not significantly higher than the base rate, indicating that such results might be linked to something like "intermediate" stability. We note a similar result for ECTN≤8, while ECTN>8 was clearly linked to stability.

INTERPRETING THE FINDINGS

In a perfect world, we would know absolutely whether a slope can be triggered or not. However, in reality, all studies exploring stability tests—including this one—must use other observations to infer slope stability. If the slope stability rating is wrong, which is inevitable for at least part of our data, then the test accuracy drops. For example, in our study we likely had at least some cases where observers did not see any signs of instability but the snowpack was still unstable and avalanches could be triggered. Similarly, there are also likely cases where observers noted signs of instability on nearby slopes, but the slope being tested was in fact stable. These situations lead to a misclassification of the slope stability and have the potential to lower the correct classification by the stability test being evaluated. However, while these cases influence absolute values, it does not influence the observed patterns in Figure 1. We can see this when we compare our much smaller Spanish data set, which was thoroughly quality-checked by the forecasters in Val d'Aran, to our U.S. and Swiss data sets, which both relied on observations submitted together with snow profiles. In Spain, the proportion of unstable locations was about 80% for ECTP≤23, and 8% for ECTN and ECTX in a data set with 35% unstable slopes (*Figure 2b*). In the U.S. and Switzerland, absolute values and the shape of the curves were remarkably similar (*Figures 2a and 2c*). The only difference was that the proportion of unstable slopes for ECTP>22 was slightly above the base rate in the U.S. and slightly below in Switzerland.

TAKE-HOME POINTS

The correlation between signs of instability and ECT scores clearly shows that the ECT is a valuable test for assessing snow instability. Our data confirms the findings in the Swiss study that

The correlation between signs of instability and ECT scores clearly shows that the ECT is a valuable test for assessing snow instability.

Jordi Gavaldà, avalanche forecaster at Val d'Aran avalanche center, performing an ECT at Montanyó d'Arreu in the Catalan Pyrenees (Spain). The ECT results were moderate to hard ECTNs. This agreed well with other observations made on this day, indicating a good bonding of the wind slab, which had formed during a storm several days earlier *Photo I. Moner.*

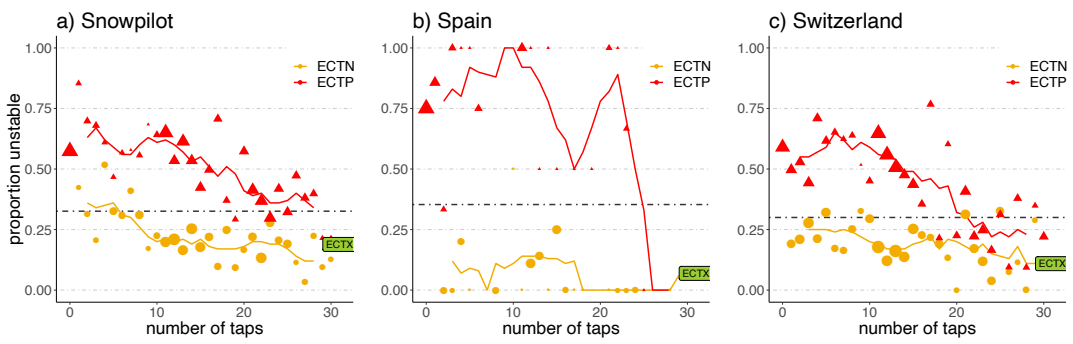


Figure 2: Proportion of unstable ECT locations for each combination of fracture propagation and number of taps until failure for the three data sets. The Snowpilot (a) and Swiss (c) results, which are based on a large number of ECT, look rather similar. In contrast, the ECT data from Spain discriminates better between ECT results indicating instability and stability, but also a much more random behavior due to the small number of ECTs.

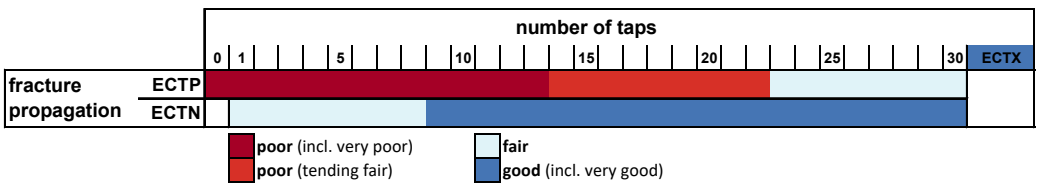


Figure 3: Relating ECT results to observed signs of instability in the surroundings in this data set. The stability class poor is split into two sub-classes, reflecting the trend seen in Figure 1 for an intermediate number of taps.

including the number of taps in addition to the propagation portion of the results can improve the overall accuracy of this test. In line with the work of Techel et al. 2020 on Swiss data, we suggest the following terms for ECT results (*see also Figure 3*).

- **Poor:** ECTPs with easy—and to a lesser extent—moderate scores. In our data, these results are clearly correlated with instability,
- **Fair:** ECTPs with high scores and ECTNs with low scores. Our results suggest these values are more of a mixed bag in terms of their association with signs of instability.
- **Good:** ECTNs with moderate and high scores as well as all ECTXs. These results are most often associated with stable conditions.

Even though this classification may help us interpret ECT results, several challenges remain: 1) selecting the right location for the test, 2) determining how representative that location is for the slope(s) of interest, and 3) understanding the inherent spatial variability of test results. Therefore, a single test with stable results should never be used as a sole indicator for stability, but should always be used in combination with many other field observations and additional tests, preferably in different locations. On the other hand, a single test with unstable results is enough to warrant extra caution.

A SIDE NOTE: FURTHER RESULTS FROM A SWISS ECT STUDY (TECHEL ET AL., 2020)

Relying on the Swiss data set, which is included in our analysis, other relevant findings were noted:

- Performing a second ECT in the same snowpit was most useful when the first ECT indicated ECTP>14 or ECTN<10. Particularly in these cases, a second ECT could tip the balance towards indicating instability or stability.
- A direct comparison of ECT results with Rutschblock tests performed in the same snow pit showed that RB test results correlated better with slope stability than ECT results. In other words, if a RB test result indicated instability, more slopes were classified as unstable, compared to an ECT indicating instability. For results indicating stability, the opposite was observed.

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Frank Techel works as avalanche forecaster at the national avalanche warning service in Davos, Switzerland, and has worked there since 2011.

Numerous avalanches occurred on the northern and western flanks of Vienna Peak in the southern Sawtooths. Many slides involved only the new snow but others broke into deeper weak layers in the snowpack. The ragged nature of these crowns was a common feature of many slides that occurred around the time of the earthquake. This area is nearly 45 miles S/SE of the epicenter of the earthquake.

The Dragons

STORY AND PHOTOS BY BEN VANDENBOS

As avalanche forecasters we use the idea of avalanche problems to help us communicate what type of hazard a traveler might encounter in the backcountry. Commonly referred to as "dragons," these sets of problems help us simplify and sort the world into patterns that we can more easily recognize, understand, and deal with. This season, the world was set to send a few novel dragons flying in our direction.

By February it was apparent that the winter of 2020 would be one for the books. Between a reactive layer of SH that spanned our forecast area and a historic January deep slab avalanche cycle in the Sawtooths, we'd been sparring with dangerous dragons all season long. At the time we had no idea that this was but a prelude for what was to come.

The first cases of Covid-19 were reported in Blaine County, ID on March 14th. The virus spread rapidly in our small and tightly knit community. By the end of March the rates of positive test results in the county surpassed even those seen in New York City. In Ketchum, home to the famed Sun Valley Resort, a large antibody study revealed that over a third of the city had been infected with the virus by early May. As the coronavirus spread in the county and the country, we warned our readers about the impact of this first new dragon on the backcountry scene.

On March 31st, following a long period of good stability, an intense storm moved into our area. With this storm we found ourselves dealing both with dragons that we knew well and the new dragon on the problem list. In the forecast discussion that morning I wrote,

"Today is the first day in two and half months that we have HIGH danger in our forecast area. The ongoing pandemic reminds us that the world can shift underneath your feet. The storm in progress should remind you of the same."

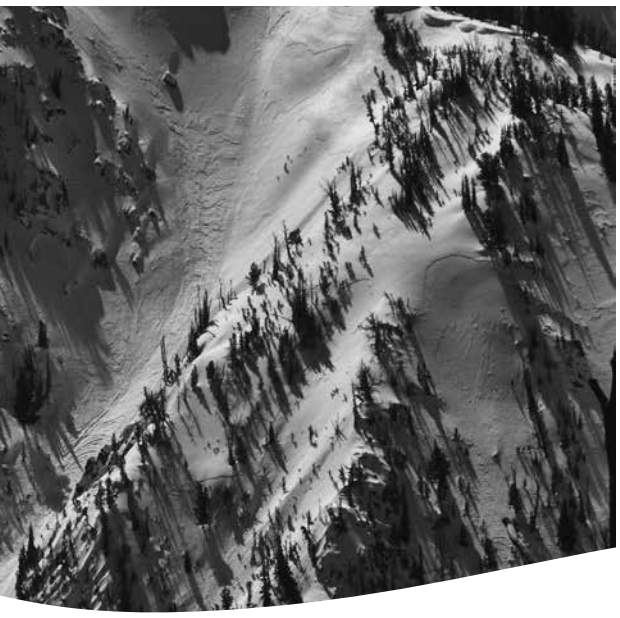
When I published the forecast that morning we were less than 12 hours out from an event that would have the ground moving underneath our feet quite literally.

At 5:52 that evening, as the ongoing storm was peaking in intensity, energy stored in the deformed crust of the earth was released in a magnitude 6.5 earthquake. At the epicenter of the earthquake, nearly three feet of new snow had accumulated during the storm. Shaking from the earthquake was felt across the state and in all of the states that border Idaho. Residents in the town of Stanley, nearly five miles from the rangefront, reported that they were able to hear the rushing of avalanches in the immediate aftermath of the earthquake.

Under normal circumstances the backcountry winter environment is highly complex. The addition of both a global pandemic and a major earthquake significantly increased this complexity this past winter. How do you travel in the backcountry knowing that any potential SAR effort could threaten the health of the rescuers? Has driving to the trailhead with your partner become one of your largest liabilities? And how do you think about entering avalanche terrain that has been

These large avalanches on Braxon and Heyburn Peaks occurred 25 miles S/SE of the epicenter of the earthquake. This area includes some of the most popular ski terrain in the Sawtooths, thanks to the nearby huts and yurts. In addition to the obvious crowns, gouged runnels created by rocks that detached and slid downslope are visible.

Sunrise above the Alturas Lake drainage reveals miles of crowns. While large avalanches were expected in upper elevation terrain, the amount of avalanche activity observed in lower, sheltered terrain was difficult to explain without the input from the earthquake. In the background is Snowyside Peak, which sits at the hydrologic divide between the Salmon and Boise rivers. This area is just under 40 miles from the epicenter.



You Don't Know

affected by an earthquake? Will the ongoing series of periodic aftershocks be enough to shake another slide loose? Or maybe rattle some rocks off the wall of the couloir you are thinking about climbing and skiing?

For me, the answer for all these questions was to wipe away my preconceived notions about backcountry travel and return to square one. I found that the first step in dealing with a novel dragon is to accept that you are grappling with a problem that you are unfamiliar with. We learn nothing when we think we know everything. Revert to an assessment mindset, open the aperture of your senses and be ready to observe and react to whatever the world might throw in your direction. Make note of how the world responds to your actions and use this to help you guide your next steps. In both the "real" world and the world of snow, this defensive posture looks like a pose we will be holding for quite some time, with or without more earthquakes.

LW: It's super interesting—I have another article in this TAR (Jonny Hepburn, page 31) talking about how, this far into pandemic world, we are in entrenchment mindset. I like having different perspectives on a topic! Makes you think.

Ben VDB: Interesting note on strategic mindset, definitely a good argument to be made that we are moving towards an entrenchment mindset. Functionally I think we are often in mixed-mode mindsets, particularly when uncertainty is high. Hard to be entrenched if you are dealing with a problem you don't understand. While both assessment and entrenchment can be exhausting over long periods of time, I find the curiosity and cautious optimism of assessment are a bit more sustainable than the pre-determined outlook of entrenchment.

I HATE *Surprises*

BY MIKE BUOTTE

Surprises are not generally welcome during the dark months of winter for Snow Safety Directors. Neither are mid-day texts from the on-duty Assistant Snow Safety Director while I'm at home on a day off; it's rarely comforting news. Especially when the first word of the text is "Surprise!" The Marx avalanche path at Big Sky Resort had avalanched as a persistent slab, D3, during mitigation work on December 9th. A 4lb. shot on a stick. I was surprised.

THE SETUP: We knew that we had a potentially unstable structure; an October of 196% of average snowfall is good for hunting, but usually makes for a long avalanche season. Of course, it stopped snowing in November, got warm, rained, and left us with a bomber basal crust on solar aspects that is still down there as I write this in April. Then it snowed a bit more, rained, and put a thinner crust over the snow sitting on the October snow crust. This trapped lower density layer faceted, and the die was cast for the winter on solar aspects in the alpine: faceted snow sitting on a perfect potential bed surface.

What had me pacing around my kitchen in circles on December 9 was what (apparently) tipped the path into instability—a paltry .34" of SWE in the previous two days without significant wind loading. This had followed a week of mostly clear skies with one small 2" at 7% squall six days prior to the avalanche. Pit data showed mostly moderate scores with Q2 results. One pit had a Q1, and there were some ECTPs. We peppered the slope with 4lb. shots. We had opened the path to skiing two days previous on December 7 under an assumption of conditionally stable, due to lack of loading, pit data, and no explosives results. The path had been closed to public the day before the avalanche due to 4" of 8% leaving isolated stubborn slabs in places, but mostly due to a nagging early season uncertainty among the forecasters.

THE DECISION-MAKING PROCESS: I cannot overstate the value of a team that has the courage to close terrain! We talk about keeping a safety margin with deep and persistent slab avalanches. One metric we use is "Was the path open the day before the avalanche?" If it was and there wasn't a significant change to the mountain overnight and we get a result, it gives us reason to reassess our margins. While we made the cut on that metric, none of us in Snow Safety thought it likely that .34" of SWE without much wind loading was going to tip the pack over, and that gave us pause. It would have felt better if the load was significant, but being at the crown and looking at a fluffy 4" of 8% sitting on various pencil hard slabs stacked to 3' deep painted a different picture. None of us called the load obviously significant.

WHICH RAISED A QUESTION: Had the path gotten weaker, and more sensitive to triggering in the time since we last shot it, exposed to (mostly) clear skies and seasonal December temperatures? Was that possible? Would we have gotten the result if we had shot the path without the 4" of snow? (Why would we have shot it? It hadn't snowed in days…) We know that snow can weaken over time (duh, right?), but get more sensitive over time? Was the weakening pronounced enough that sensitivity to triggering was increased? I have often made the argument that subtle changes in loading can be the difference between little to no persistent/deep slab activity and a full blown cycle, and I stand by that. (I have observed this mostly over prolonged but low/moderate precipitation storm cycles, where there is loading, we are expecting paths to fail, they don't, we scratch our heads, then get a little more snow and little more wind and the cycle is on…) But subtle weakening tipping the scale?

A surprise left by a fox, or maybe two, on Grand Mesa, Colorado, February 2020. *Photo Kelly Elder*

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COMMENTS FROM KARL

In some of the work I did with Chris Landry and then later with Erich Lutz, Spencer Logan, and Kalle Kronholm, we attempted to look at changes in spatial variability over time (Birkeland and Landry, 2002). Two things to remember when referring back to this research: 1) It was largely conceptual because we found it so challenging to collect good data on temporal changes in spatial variability, and 2) We hypothesized—based on some work in other fields—that the spatial variability would increase as the snow strengthened (in other words, the difference between the weakest snow and the strongest snow would get larger). While some of our work supported this idea and its implications (e.g., Kronholm and Birkeland, 2005; Logan, 2005; Logan et al., 2007; Lutz, 2009), the field evidence was not definitive.

What does this mean for triggering due to weakening? I'm not sure. I like the way Mike puts it in his article…that it would not be something he would emphasize in his decision-making, but that it might be a small factor that he would consider. My own guess is that the weakening of the snowpack is likely a very minor player in this whole scenario or what we'd call a 2nd (or 3rd or 4th) order effect.

If we think of things in terms of how the snow fractures, then the ease of triggering is inversely proportional to load (more load = easier to trigger), and directly proportional to both slab stiffness (less stiff slab = easier to trigger) and weak layer specific fracture energy (weaker weak layer = easier to trigger) (Schweizer et al., 2016). In this case the load increased (but not by much!), the slab stiffness was probably very nearly the same, and the weak layer might (??) have gotten just a tiny bit weaker.

If I had to guess—and it would only be a guess—what happened in the Big Sky avalanche that Mike writes about, I'd say that the 4 pounds on a stick was in just the right spot to trigger the avalanche. It sounds like the slope had been thoroughly controlled with explosives already, but maybe this particular shot was simply "the right charge in the right place at the right time", as Norm Wilson used to say. And, maybe that four inches of snow added just enough sensitivity to the pack that when the right airblast was put in the right spot the slope released.

Hearing that all that hangfire released with just a 2-pounder in the snow was certainly surprising to me. Like Mike, I would definitely have expected that to go with the first avalanche. But, for some reason this was also the right shot in the right place at the right time!

These are just my quick thoughts. A big thanks to Mike for a solid and thought-provoking article.

—Karl Birkeland, Director of the Forest Service National Avalanche Center

SO, WHAT ARE MY OPERATIONAL TAKEAWAYS? After this avalanche, weakening and sensitivity is something I will at least consider going forward, especially during periods of "conditionally stable" where we expect to get avalanches once the path(s) load up…If the structure is poor, but there is no additional loading, we'll consider some targeted test shooting during the interval between storms, especially if the interval is long and the temps are cold and the pack is thin. Even if it is not super cold, clear night skies can really drive gradients. Upon initial openings, we will blast more thoroughly, which we do anyway—we are a noisy patrol in December and January, for sure. We'll never know if we had tried harder if we would have gotten the result earlier in the week before the path opened. It oftentimes feels stupid to bash away at a path with explosives when it hasn't snowed in five days. In alpine paths with poor structure and thin packs I'll take feeling stupid and a bunch of holes in the snow over walking around in circles in the kitchen hating surprises.

AND FINALLY, ANOTHER CAUTIONARY TALE. After walking around in circles in the kitchen I did the obvious thing to ease my mind—I got in the car, drove up to the resort, put on my uniform and went and looked at the thing. The avalanche had taken the bottom 2/3 of the path leaving the top part hanging, which is typical of the Marx path. I was with two other patrollers going to look at the slide and we were in the top of the path, and were thinking that the top part was probably stable that day; after all, it would have gone with the bottom half a few hours ago if it wanted to go, right? After a brief discussion of travel protocol, I tapped the brakes and decided we would travel one at a time, and asked a fourth patroller who was looking at the crown to move off before we dropped. All good. The next day the top half where we were standing came down with a 2lb. shot after a trace of snow overnight.

It's good to get surprised. It keeps us honest, keeps us humble, and has a tendency to re-focus on protocols, safety, and honoring uncertainty. I still hate surprises, though.

Thanks to Don Sharaf, Kelly Elder and Andy Lapkass for considering the "increased sensitivity over time due to weakening" possibility when I threw it out to Don who then passed it on last December. No one is saying "Yeah, this happens for sure." But plausible? Maybe so…I hadn't thought much about it before.

I read Karl's response—a good review of his research. I still don't know exactly what to think. I'm certain that there had been shots very close to where we subsequently triggered the path—it is the known "sweet spot" and is a go-to placement when we are gunning for the path. And we were gunning for it earlier in the week before we opened.

I've been trying to think about it from the point of view of a forecaster who is not familiar with Big Sky, and an easy conclusion might be that we simply underestimated the amount of load in the path. It was paltry at the crown, but was there more down in the gut that slid to the bottom? Maybe, but no one in Snow Safety felt like this was an expected result on that day. It caught us all off guard, and set a tone for the season—it was tricky to forecast what was going to break and when, and that unease and paranoia stayed with us all season long. It pretty much sucked for decision-makers—this is the only season I have ever wondered if we were actually BEING careful when we were trying hard to be careful and conservative.

— Mike Buotte

LIVING WITH

UNcertainty...

THE REST OF THE WORLD GETS A TASTE OF WHAT IT'S LIKE TO DEAL WITH AVALANCHES.

A CERTAIN UNcertainty

This essay first appeared on Backcountry Magazine*'s website.*

BY DAVE RICHARDS

COVID-19, MASKS AND POLITICS, OH MY! What a wake up call—finally, the rest of the world gets a taste of what it's like to deal with avalanches. Here I present you with a learning opportunity, so to speak.

Perhaps experienced backcountry skiers and avalanche workers are better qualified than most to deal with the current global environment. Maybe we could even write government policy from the skintrack? Kidding, of course. But it is no joke that the new state of the world has forced everyone to face some hard truths. The biggest of which is this: the world is uncertain. This is not as safe a place as you may have thought it was. Any good avalanche worker or experienced backcountry skier could have told you this years ago. If you are looking for certainty, you came to the wrong planet. Further, if you are looking for certainty in the mountains as you go forth and recreate, you have indeed picked the wrong passion.

The world of snow—whether it be seen from the point of view of an operational avalanche forecaster, guide, or the brand-new backcountry skier—is an inherently dangerous and uncertain place. Snow is constantly changing: what was dangerous five days ago is now stable, what was soft powder an hour ago is now a wet slide waiting to happen, and what looked like a perfectly skiable line from the trailhead doesn't feel so good when you reach the top. Acknowledging these changes and being prepared to accept the lack of solid data or facts is what makes you understand snow and the mountains. It is only after becoming comfortable with this uncertainty that you will function well in this ever-evolving environment.

In the case of working and recreating in avalanche terrain, we not only live with the uncertainty of the snowpack and mountain environment, but also understand and accept the risk associated with it. The ski resort forecaster does everything in their power to reduce risk but recognizes that it cannot be completely eliminated. The backcountry skier studies snow and does a slope cut, but eventually has to makes that first fall line turn, understanding that there is some unknown (and thus risk) involved. If you are not willing to accept that unknown, then what are you doing here?

Based on my experience in the mountains, I will offer you my advice: if you want to play, you need to embrace vast uncertainty and accept the associated risks. Know beyond any doubt that you cannot ever eliminate risk completely. In the mountains, there is no total control. Instead, we do everything in our power to understand the situation and mitigate risk based on this incomplete understanding. We always recognize that in the end something else can (and will) go wrong. That is a fact. When it does, you react accordingly. If you can look back and say you did your best regardless of the outcome, then you can continue to move forward. In this business, being able to honestly say you did your best in the face of uncertainty is what will allow you to sleep at night, and, more importantly, to go back out and ski again tomorrow.

How do you do your best? Embrace uncertainty. Say, "I don't know." Uncertain situations will by definition lead you to not knowing, and that is okay. When we admit that we don't know, we give ourselves permission to be vulnerable. More importantly, we recognize a starting point from which to gather information. Then eventually we might be able to say that we do know, whether that be what aspect a persistent weak layer is lingering on or how fast Covid-19 is spreading at a county, state, and national level.

Uncertainty usually means that we can't predict the future, so instead we have to plan ahead and then work with what the world throws at us. IMPROVISE, ADAPT, AND OVERCOME. Things will happen. Stay nimble, and keep moving. If you have done some planning for the "what ifs," then this improvisation will be easier.

In avalanches, just as in the world of pandemics and politics, uncertainty is, in fact, certain. And we must all learn to accept that. ⬢

THIS IS NOT THE SAFE PLACE YOU MAY HAVE THOUGHT IT WAS.

What We Learn From Winter:

INSIGHTS FOR A PANDEMIC

BY JONNY HEPBURN

AVALANCHES ARE POWERFUL, DESTRUCTIVE, AND AMBIVALENT. So are viruses. What can avalanche science teach us about risk in a time of pandemic?

Ever since the Canadian Pacific Railway was built over Rogers Pass in 1884, Canadian industry became reliant on avalanche control—the railroad passes under 184 active avalanche paths as it works its way through the west.

Canadian avalanche professionals have consistently driven the art and science of understanding avalanches. For many years, the focus was on important physical questions: Where will avalanches happen? When will they happen? What triggers them?

Avalanche hazard can be conceptualized using the following physical factors:

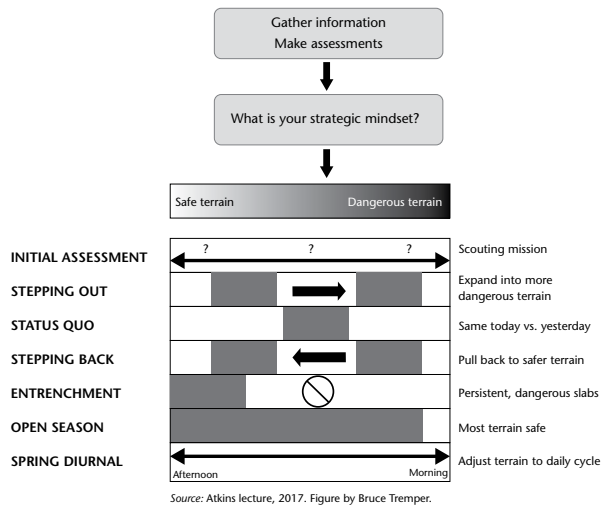
1. **Snowpack:** What is happening beneath the surface?
2. **Terrain:** Is this slope capable of producing an avalanche?
3. **Weather:** Are conditions getting more or less stable?

Critically, a fourth factor is present whenever people step into the mountains.

4. **Humans:** Are we making good decisions?

Physical factors transfer easily to our current moment:

1. An invisible threat lurks out of view. Its distribution is widespread.
2. We select safer terrain by staying at home and minimizing our exposure to hazard.
3. Conditions remain unstable.



Source: Atkins lecture, 2017. Figure by Bruce Tremper.

In spite of the physicality of avalanches, managing avalanche hazard is primarily an exercise in understanding **human decision-making.** How do people make collaborative decisions when faced with incomplete information about a complex, invisible hazard?

Strategic Mindsets have become a critical tool for avalanche professionals that can provide us with valuable Covid-19 framing. If we can deliberately select a mindset that is appropriate for the conditions, that mindset can guide our decision making. We prime ourselves to act in a certain way. (The tool was shared in 2014 by Roger Atkins, a long time Canadian ski guide.) In new locations we adopt an **Assessment** mindset. When all is well, we can operate in **Open Season**—all terrain is available; we are very confident in our assessment.

While there is a range of mindsets to explore, in our extended moment of separation we are in the midst of a period of **Entrenchment**. Hazardous conditions persist, and only the most conservative terrain selection is appropriate. While some avalanche problems heal in days, Entrenchment is the necessary operating mindset when deep, scary, reactive problems persist in the snowpack for weeks, months, or a whole season. Covid-19 demands such a mindset.

Entrenchment is challenging and demands discipline. We remind ourselves of our mindset, and let it guide our choices. We need to be patient, continue to make assessments, and only adjust our mindset when we have compelling data to support a cautious **Stepping Out**. In the absence of such data, Stepping Out from a place of impatience is its own hazard.

We will return to our shared spaces, our offices, our loved ones' homes. Impatience is our challenge. The practice of mountain travel reminds us that we cannot exert our will on external conditions: we control what we can and work to live in harmony with what we cannot. ⬢

Changing My Tune...

OR USING MY PROFESSIONAL AVALANCHE VOCABULARY IN A NEW APPLICATION

STORY AND PHOTO BY ROB COPPOLILLO

WAY BACK IN APRIL, I conned my friends at WildSnow.com into publishing some of my blathering about the coronavirus, risk, uncertainty, and the overall vibe here in Chamonix, France. Ski season had just ended, not due to lack of snow or rain, but by decree. We were forbidden to ski, forbidden to guide, forbidden to do much of anything, but I still had my avalanche hat on.

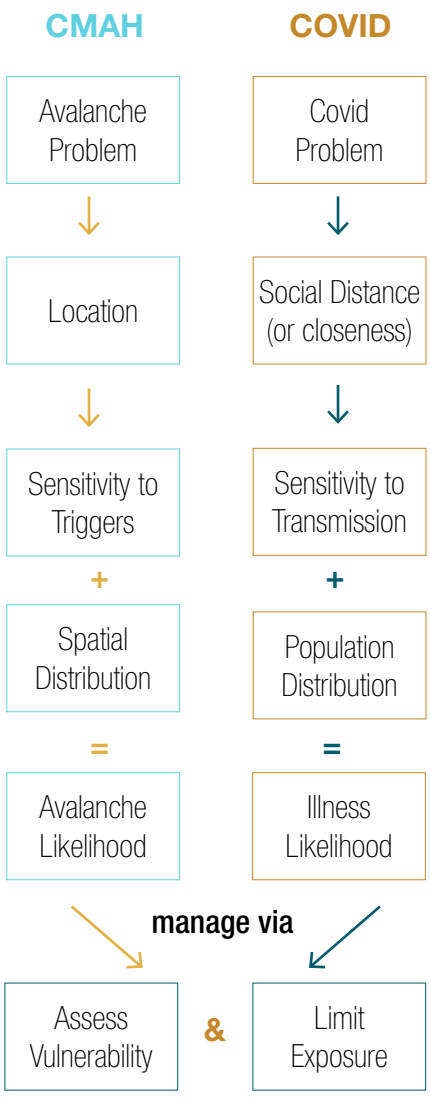
Back then I filtered the news and contradictory information through a lens … call it a conceptual model of Covid hazard, an amateur-hour adaptation of the conceptual model of avalanche hazard (CMAH), the seminal 2012 model/paper authored by Statham, Birkeland, Greene, Haegeli et al.

In early April the pandemic seemed like touring with a deep-slab problem, mainly because of the uncertainty and the daily images of the dead. Being eleven kilometers from the epicenter, Italy, probably skewed my perception. WildSnow readers commented with some insightful thoughts, disagreements over the avalanche character, and the like. One commenter, "Slim," rightly pointed out that the deep-slab metaphor fails because it's a "low-probability, high-consequence" event: nowadays we recognize the high probability of being infected, the low probability of complications, but then again the unbelievably high consequences if we do suffer complications. It's complicated.

One obvious takeaway: metaphors, in the hands of a punter like me, are probably more trouble than they're worth.

Now it's August. I just re-read the WildSnow piece. My family and I just returned from a beach mission to southern Italy, no snow in sight, almost 100 degrees F, haven't worked or skied in months. Italy has become an international success story: fewer than 50 Covid patients in the ICU for the whole nation of 60 million people. Texas, as of July 1, had 1500 Covid patients in the ICU.

I said, back in April, "Let's hope I'm still singing this tune in a week or so…," referring to France's situation. Since then another 27,000 people have died here. The US just passed 160,000 dead. So much shifting, contradictory, confounding information leaves room for



A seven-centimeter ice layer from a rain event beneath 70cm of fresh...with another 60-80cm forecast that night. Widespread cycle and we were the last ones at the hut, but the potential to be marooned indoors for days spooked us and we bailed to Verbier. John Morrone harvests the goods on the escape from the Chabod hut, Gran Paradiso National Park, Italy.

anti-maskers, conspiracy theorists, and paranoid commies like me to get carried away with our own thoughts. I'm quick to say that I've certainly changed my tune!

Or have I? What has actually changed? Indeed, Italy has improved, the US has worsened, but for an unemployed mountain guide at home, am I more or less certain about Covid and its risks? Contracting it, the effects, the recovery, my kids, future work? The situation seems far worse, especially watching the US from abroad, but I'm not quite sure I have any better handle on the situation.

THE MODEL

Ski patrollers, recreationists, forecasters, and researchers all manage avalanche problems. I come at the problem most days as a mountain guide. Where do I take my guests for good skiing? In the same breath, though, as one of my mentors says, "Our job is to ski where the danger is low."

But how do we know where the danger is low? Let me try and filter the Covid problem through the CMAH.

AVALANCHE CHARACTER

It helps to identify the nature of the problem. Is Covid a deep slab, low-probability, high-consequence event? Well, kind of, but like my buddy Slim opined, it's actually super-low consequence for most of us, and super-high probability of getting it from that anti-masker mouth-breather on the plane next to me. Maybe Covid is more of a touchy, shallow, wind slab—high likelihood of triggering (contracting) it, but as long as you're not perched above a cliff (underlying health condition, genetic predisposition, susceptible blood type?), pretty low-consequence. But then again, is anybody reasonably sure why some people implode while most of us simply keep spreading it?

UNCERTAINTY FACTOR FOR CHARACTER: 7/10

LOCATION

Somebody smart just said on the American news the virus is "extraordinarily widespread." So we can find our main avalanche type (was it a deep slab or a wind slab?!) just about everywhere in terms of elevation, aspect, operating zone, etc. Bars, restaurants, Sunday church, packed trailheads, midday dance club in a Speedo on Daytona Beach. Sounds more like a storm slab or a persistent slab—all aspects, all elevations, everywhere we want to ski. Damn, the plot thickens.

UNCERTAINTY FACTOR FOR LOCATION: 1/10

SENSITIVITY TO TRIGGERS + SPATIAL DISTRIBUTION = LIKELIHOOD

Yes, friends, we have now introduced a worded math problem. And you thought the SAT sucked. Spatial distribution is widespread and evidence is "everywhere and easy to find." I'd say so.

And sensitivity? Well, it seems like Covid is very transmissible, so you could argue it's Very Touchy (triggering certain), but hang on—very few people (relative to the overall population) develop complications, so you might just as well argue it's Stubborn (Difficult human triggering).

UNCERTAINTY FACTOR: 6/10

AVALANCHE HAZARD AND DESTRUCTIVE SIZE (AKA CONSEQUENCES)

We take our character, location, and likelihood, and we determine the potential for an avalanche to harm something of value; namely, you and me.

The brainy forecasters express hazard as Low, Moderate, Considerable, etc. So what do we have here? Are we in a widespread avalanche cycle, or merely watching out for that isolated, unlikely outlier? Here's where I veer back towards a deep-slab problem, as it's pretty unlikely you and I (being strong as Vikings and protected by the gods) will suffer much, but boy, if we did—lights out.

Consequences (destructive size) range from sluffed off your feet (size 1 or less; mild-to-no symptoms) to death (oops, it went size 3.5 into timber; sedation and intubation!). And this doesn't include getting your partners nuked: you trigger the slope above and kill your diabetic, elderly auntie who survived breast cancer. Way to go, dude.

So, is it Moderate with a deep-slab problem, or High with a wind-slab problem? Size 1-2 and easily identified/avoided or 3.5 and up, and really hard to identify in the field? I'm confused and my caffeine is wearing off … no clue.

UNCERTAINTY FACTOR: 8/10

EXPOSURE AND VULNERABILITY

Exposure, with Covid and avalanches, the easiest of all to work in your favor! Stay out of avalanche terrain, period. Wear a mask, stay distanced, no trains, forget CrossFit, and for the love of Pete … cancel on that Princess Cruise, my friend!

And last, Vulnerability might be the most "unknowable" variable of all: I've seen articles on everything from blood type, to genetics, to household demographics, to vitamin D, to kooky snake-oil preachers calling out Covid demons in packed (maskless) holy gatherings, all as risk factors for dying of Covid. Good luck making sense of this one.

UNCERTAINTY FACTOR: 10/10

WISE CONCLUSIONS (& UNCERTAINTY)

None whatsoever. I got you again—you read all the way to the end, only to find yourself more confused than when you started. It's my calling card for tackling complex topics and wicked environments.

After a few more months of Covid, France has looked pretty good, but now numbers are beginning to climb again. Japan and Oz have had to backtrack on reopenings. Promises of the virus disappearing have proven utterly wrong.

Factor in uncertainty. My weak attempts at gauging Covid hazard fall even shorter than in the spring. I've read hundreds of thousands of words on the topic and I still can't say with any certainty how vulnerable I might be and what happens if I pick up the bug from that hollering Italian on the tram.

SO WHAT DO I DO?

The answer becomes the same as a morning with an unfamiliar weather event or a new-and-novel snowpack or a testy surface-hoar layer in a new drainage: too much uncertainty, so I'm dialing the game back. Way back. Loading in more margin than I thought necessary, but still trying to live heartily and ski some decent powder. And make it back home again.

Masks, distance, hand-washing, picnic-in-a-park instead of indoors at a restaurant. Despite my best efforts at educating myself on decision-making and the virus, I find myself more confused than ever. If education is "the path from cocky ignorance to miserable uncertainty," then I guess I'm on it. **Stay safe, friends.**

No One Is Coming, It's Up To Us.

A MEDITATION ON OUTDOOR RECREATION IN THE COVID TIMES

BY DOUG BRAUMBERGER

I HAVE THE RIGHT TO...OR DO I?

"WHEN DOES THE WELL-BEING OF THE COMMUNITY AT LARGE OUTWEIGH OUR PERSONAL FREEDOM TO RECREATE?"

Under normal circumstances, as individuals, we have an attitude exemplified by the statement "this is an acceptable risk." But we are not under normal circumstances and this isn't an individual or even small group decision, but one that has the potential to impact a large number of individuals (doctors, nurses, hospital staff, volunteer SAR, extending to all their families, etc.) that may not share that same level of risk. Should they be forced to accept this risk due to the actions of a few?

HOPE IS NOT A GOOD PLAN!

I'm personally struggling with the lack of preparation and risk tolerance I've seen from some. It seemed like a no-brainer to me, dial it way down or just trade the skis for a mountain bike and start riding. But as the snow kept falling my desire to ski was there, so I went to our local hill to fulfill that need. What surprised and then shocked me was the number of people out there engaging in an activity with no previous knowledge or experience. If this was happening here was it happening in the backcountry? And as the season progressed, the answer was yes. As more people who did not have the appropriate equipment or awareness of safe routes were heading to avalanche-prone slopes, there was an increase in human-caused avalanches, some resulting in fatalities. People were also congregating in large groups in parking lots, trailheads, and on trails, which then caused more communities to deny uphill access to slopes and in some cases close down roadside parking areas thus restricting access to trailheads.

WHY WAS IT SO HARD TO JUST STEP BACK AND RE-EVALUATE WHY WE ARE COMPROMISING OUR LARGER COMMUNITY?

One explanation might be that while we support the small, select community we engage in, we seem to be neglecting the larger community which we live in as implicated by Social Capital Theory.

"This theory posits that our lives are made more productive with social ties. Just as we have basic needs for food, water, and shelter, the need for social connection is crucial to our well-being. Sadly, as our communities are unraveling, Americans are becoming more isolated and disengaged than ever before[1]."

This, in my opinion, is one of the reasons we are seeing more disregard for the well-being of others outside of our immediate community or group. It's not a recent phenomenon but one that began in the 1980s with more people living alone, having fewer children, and engaging less in social groups. The use of modern technology as a primary form of communication is also contributing to this situation, further disengaging us from the large community.

DOING IS GREATER THAN TALKING.

WHAT ARE OUR RESPONSIBILITIES IN PROMOTING PROSOCIAL BEHAVIOR?

What is prosocial behavior? It's behavior that occurs when "someone is altruistic and helps another person without expecting something in return. More realistically, prosocial behavior is a blend of empathy and concern about the welfare and rights of others, combined with egoistic or pragmatic motivations[2]."

With the potential increase in new backcountry users this season I believe we have a unique opportunity to address this issue. Now I'm not being Pollyanna about this since I realize that some individuals out there will disregard any effort we make, but education is key. And if we can begin to re-develop more prosocial behavior, then we have a chance to reduce the number of possible backcountry incidents resulting in increased contact with rescue personnel, healthcare workers, and others within the larger community.

With that in mind we could expand the recreational avalanche classes or offer specific courses to include the following:

1. Incorporate specific "what ifs" for an injured party member and the impacts to the community into your touring plan.
2. Self-reliance/rescue. Be prepared and identify who's responsible for what? Communications, first aid, snow safety, overnight gear, and extra food. Plans will be different for a group of two than a group of four. Know your group's ability, both fitness, and skiing, and stay within it.
3. Invite local healthcare providers or SARs to come in as guest speakers to explain the possible consequences of your actions.

Here's an example of our touring preparation when I lived in Canada. We designated specific gear responsibilities to each individual in our tour group. One person the satellite phone or Spot, another person packs the first aid kit, the size of the kit dependent on the group size, another the snow study kit, and each individual would bring extra food and a bivy bag or rescue blanket in case we had to stay overnight. In addition, we left a credit card number with the local heliski outfitter in case we needed air support or transportation. We made every effort to prepare for self-rescue and be self-sufficient if required.

Local retail stores also have a role in this. They shouldn't assume individuals buying or renting gear know what they are doing. Ask them to spend time, if necessary, explaining and demonstrating proper gear use. Provide them with Youtube tutorials for future reference.

I'm not a psychologist, sociologist, or behavior specialist. So all that I have written is just my opinion based on personal observations and my desire to make some sense of all that's going on today. The suggestions I've offered are just that, suggestions. Whether they have any impact is to be determined by the reader. As for me, I now have a more clear understanding of my questions but still have more to learn.

1 *Psychology Today,* Isolated Nation Jan. 15, 2019

2 *Psychology Today,* Positive Actions Build Social Capital and Resilience June 17, 2013

Anything but Normal...

Look for Part 2, a focus on the smaller avalanche centers, in TAR 39.2

NATIONAL AVALANCHE CENTER

The 2019–20 winter started out normally enough. It snowed, the wind blew, and, of course, avalanches released. However, the arrival of Covid 19 meant that the end of the season was anything but normal. The new reality affected every community and Avalanche Center, and our operations will continue to face new and challenging decisions in the season ahead. From a national perspective, each community faced the crisis a little bit differently, and each of our avalanche centers had to adapt their operational decisions to their local conditions.

During the 2019–20 season Karl was fortunate enough to land a fellowship to work with colleagues at the SLF in Switzerland. Despite being chased home a few months early by the virus and ensuing international travel chaos, he was thankful for the time he spent with overseas friends and colleagues. While Karl kept up with some projects remotely, Simon stepped in to pick up the slack and carry things forward. Simon's biggest project was working on developing and housing collaborative web technology for avalanche centers. The focus of this project is to push towards shared technology for avalanche centers, and we will be announcing the availability of the new National Forecasting Platform later in the summer (A BIG thanks to Chris Lundy for all his work on this project!).

Despite the Covid-related challenges, avalanche centers continue their fantastic public safety work and to be model programs for partnerships. The group's websites were accessed by more than 1.5 million people who used our forecasts more than 10 million times. In addition, avalanche centers and associated friends groups provided free and low-cost avalanche education to tens of thousands of people. All of this work gets done because partners and communities contribute just under two thirds of Avalanche Center budgets nationwide—a reality that underscores both the quality of the work being done, and the commitment and buy-in of local communities to the avalanche center missions.

The season's avalanche fatality total stands at 23. This includes 10 snowmobilers, eight skiers, three snowboarders, two hikers, and one fatality in a roof avalanche. Four of these skiers died within ski area boundaries. We continue to be heartened that the long term average for avalanche fatalities remains relatively steady for the past 20+ years at around 25 annually. This steady fatality number, combined with the dramatic increases in the use of the backcountry, mean that the *avalanche fatality rate has dropped dramatically* over that same time period. Our work is not done, but our work is making a difference.

NWAC: A wet slab on Sauk Mountain in NWAC's West Central Zone during the initial "Stay at Home" orders from the Governor. There may have been a more widespread wet slab avalanche cycle in the Cascades during this time, but very few people were out in the mountains, so it was poorly documented. *Photo John Scurlock*

In closing, we want to wish you all a healthy and happy upcoming winter and offer up a sincere thanks to all who work with and support avalanche centers.

—Simon Trautman and Karl Birkeland

NORTHWEST AVALANCHE CENTER

PROGRAM HIGHLIGHTS

2019–20 marked another year of significant change and growth for the Northwest Avalanche Center. Dennis D'Amico took the reins as forecast director while Simon Trautman shifted from his director detail to find a warm welcome and plenty of work waiting at his NAC post. Together with Executive Director Scott Schell, we focused on increasing NWAC's operational capacity and community outreach and education.

The addition of two avalanche specialists brought NWAC one step closer to realizing our long term staffing goals. Peter Moore became NWAC's first

forecaster of any physical science discipline in Oregon. Peter did an amazing job connecting NWAC with the local community while learning a new position. The Mt. Hood avalanche forecast has seen 100% growth over the last two seasons (3rd most viewed zone) . New forecaster Andrew Harrington successfully integrated into our program as well. Andy stayed on with NWAC through June; he took a deep dive into NWAC's weather station network both in terms of hardware and programming. Forecaster Dallas Glass took on an expanded role, joining the mountain weather forecasting team several days a month out of the NOAA office. Molly Scudder rounded out the seasonal staff changes, having an immediate impact with the non-profit team focused on outreach and communications. Finally, we're proud to have procured and integrated the first official fleet of sleds into our program thanks to a partnership with Clem's Enumclaw Powersports.

Throughout the winter season we reached 9800 participants through new or expanded education and outreach programs designed to better address unmet needs in avalanche education. We ran the second year of our Youth Ambassador Program, a project that gives high school students the tools to teach and engage with their peers around backcountry safety, and our third year of the Trailhead Outreach Project which puts NWAC tents at popular trailheads staffed by volunteers.

We also piloted a Women's Mentorship program designed at providing women with concrete steps toward working in the snow sciences. Finally, following restrictions around Covid, we shifted our emphasis to innovative online programming that we plan to make a staple of our classes moving forward. Despite a short season, we were pleased that engagement was at an all-time high. Membership grew from just over 2,000 members in 2018/19 to over 3,000 members this season. In a resounding note of support from our community after the season, we doubled our financial goal during our May "Give Big" Fundraiser.

SEASON REVIEW

The 2019–2020 winter began late and ended early. Our early season snowpack was shallow, limiting on snow recreation to islands of upper elevation alpine terrain. We began issuing "Conditions Reports" on November 22 and regular daily forecasts on December 11. Storms picked up around the winter solstice, laying down a thick blanket of new snow quickly; one North Cascades Snotel picked up 47" in 24 hours. The whipsaw from having low snow cover to High danger within a 24-hour period led to Avalanche Warnings for seven of our 10 zones on December 20. Even with this storm, long-term weather stations sat near or below 50% of average snow depth as 2019 came to a close.

New Year's Eve brought an incredibly windy and warm storm to the region. Several close calls and unintentionally triggered slides occurred near Washington Pass shortly after NYE due to a layer of buried surface hoar from December 27. This layer was likely the same culprit related to avalanche fatalities in early January near the Coquihalla Highway, BC and Wardner Peak, ID.

Following an early January warmup, temperatures plummeted and the Pacific Northwest powder factory churned on a daily basis, making for a memorable January if you like your snow cold, dry, and consistent. During a remarkable and extended storm cycle that lasted through early February, numerous Cascade west-side locations averaged over 1" of SWE/day over a five-week period. Snoqualmie Pass observed the second wettest month since records began in the mid 80s (Jan: 33.85" SWE) and Mt. Baker recorded 57" SWE over 39 days!

Sadly a roof avalanche fatality occurred in a residential neighborhood off Highway 97 near Blewett Pass on January 23. This accident coincided with a series of warm atmospheric river events in an unusual NW flow that resulted in several avalanche cycles through early February. Coming from an extended cold and snowy period, it was like stepping out of the freezer and into a prolonged subtropical rainstorm. As heavy rain fell to over 8,000ft in all our mountains, many rivers on the west side of the Cascades reached major flood stage, producing landslides and multi-day road closures in the Mt. Rainier and Crystal area.

Although several avalanche involvements occurred during the first half of February across the WA Cascades, all ended with minor injuries and no fatalities. Recreationists on the volcanoes of southern Washington and Mt Hood battled slide-for-life conditions the latter half of the month with two separate fatalities on Mt Hood due to icy conditions.

While Covid dominated the late season news, March was uneventful avalanche and weather-wise.

COVID

The onset of Covid-19 presented one of the most challenging operational decisions we've ever faced as an organization. Looking back, the Greater Seattle area became the first known hotzone in the U.S. with Washington State declaring a State of Emergency on Leap Day. As the weeks passed, the virus transitioned from an abstract headline to something real; three members of the forecast team entered self-quarantine in March due to exposure.

During a period of remarkable uncertainty, it became clear our operational decisions needed to be driven by local conditions. We suspended daily avalanche forecasts on March 24th to both protect our staff and support the Stay at Home orders issued by the Governors of Washington and Oregon. Prior to the Stay at Home orders, avalanche forecast use had dipped 40% week over week as ski areas closed and many folks pulled back. However, we know that backcountry use did not stop during this period. Robust backcountry gear sales and packed ski area parking lots and trailheads made our operational pause untenable from a public safety perspective.

With a significant storm cycle beginning in early April, we pushed our Forest at the local level to take a position on access. While we don't know what if any impact we had, on March 27th, USFS Region 6 aligned with the Washington and Oregon Stay At Home Orders by closing developed recreational facilities and sno-parks, and enforcing ski area lot closures. The National Park Service had already closed winter access points. With more clarity around access points, we ended avalanche forecasting for the season on March 30, while continuing barebone mountain weather ops through April 12. While we will never feel good about ending forecast operations early, I firmly believe our process led to the right choice for our organization at the time.

By working as one organization with NWAC's non-profit staff, we were able to communicate clearly and often to our community what steps we were taking and why. Whatever next season brings, we will learn from our experience and prepare to operate in the new normal.

—Dennis D'Amico, Charlotte Guard, and Matt Primomo

PAYETTE AVALANCHE CENTER

Winter started early in the West Central Mountains last fall with our first significant snowfall occurring in late October. November and early December brought cold temperatures and the formation of a weak basal layer that would persist into mid-winter on multiple aspects. PAC issued the first advisory of the year on December 20. We listed a buffet of problems: basal facets, buried surface hoar, wind slab, variability, and a very shallow snowpack below 6500 feet.

December 23 brought spring-like temperatures, sunny skies and the first of many near misses for the season with a solo, out of bounds skier triggering and becoming partially buried in a R3-D2.5 avalanche adjacent to Brundage Mountain Ski Area. This was one of many incidents that occurred as conditions were transitioning from Considerable to Moderate Hazard. By January 1 snow began

PAC: Snowmobile Partial Burial Pilot Peak. *Photo unknown, it was submitted as an anonymous observation.*

accumulating at all elevations, shallow wind slabs and storm slabs were added to the persistent weak layer problems, skiers and snowmobilers continued to find sensitive areas in the upper elevations but managed to escape unharmed. The hazard level wavered in the nebulous zone at the boundary between Moderate and Considerable with relatively widespread hazard confined to specific areas, which were precisely the places that skiers and snowmobilers wanted to ride to find the best snow.

Mid-January storms doubled the snowpack; natural avalanche cycles occurred and were covered up during a week of intense storms. Partially buried crowns and filled in paths were the only evidence of this cycle. As the storms tapered off, the West Central experienced another large avalanche cycle with several days of incremental loading and wind transport that were apparently just enough to tip the scales on the basal facet problem. High Consequence/Low Probability hazards kept most savvy recreationists off the steeps and out of avalanche terrain. January finished out with periods of light precipitation and several high pressure cycles that added another persistent layer of surface hoar.

Early February storms brought another series of storms that doubled the snowpack and added a layer of high density snow. During this cycle, off trail travel was limited to only the largest mountain sleds and a handful of skiers that found conditions too deep to ski. Several mid storm avalanches were triggered by snowmobilers on smaller mid elevation slopes and another skier triggered avalanche adjacent to the Brundage Mountain Ski Area. This cycle effectively crushed or flushed the remaining deep and mid snowpack problems setting the stage for an outstanding finish to February and most of March.

This month-long period of good stability saw shallow wind slabs and light storm snow replacing the complex snowpack problems of the first half of the winter with more tangible and easier to predict (and avoid) problems. Skiers had a blast pushing slope angles and getting into seldom skied lines in remote areas. Snowmobilers pushed everything getting into steep and complex terrain. A handful of outlier events occurred during this timeframe and provided PAC forecasters an opportunity to reiterate the message that LOW hazard does not mean NO hazard, most notably were two natural avalanches that released days after any new snow in areas that were receiving light loading and had been literally pounded by high markers for days after the most recent snowfall. The other incident involved a savvy local snow professional being taken for a scary ride during an extended high pressure in a cross loaded gully.

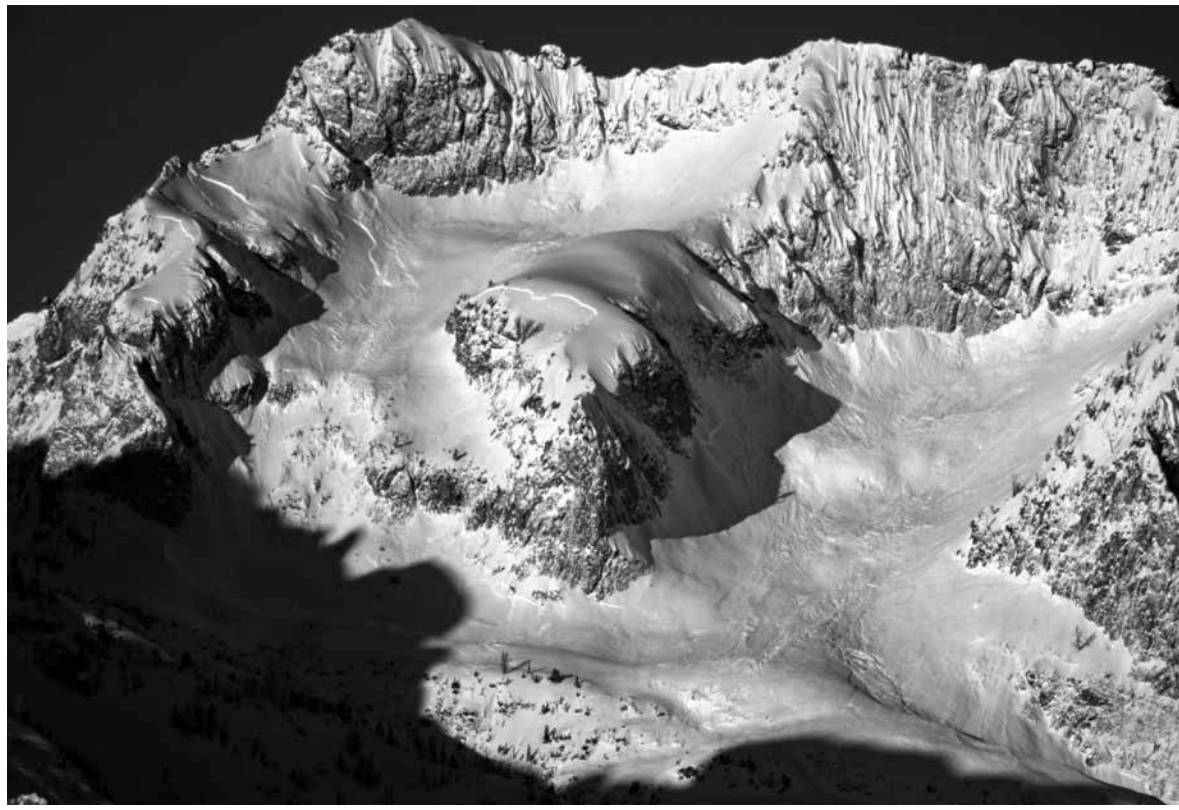
PAC issued three Backcountry Updates and 61 Advisories, of these, six advisories were for High Hazard and nine for Low Hazard. PAC closed its doors two weeks early due to the Covid-19 Virus and an effort to limit the influx of people traveling to the area and recreating during the non-essential travel ban which was widely disregarded.

PAC and the Friends of PAC put on a total of five classes this winter with FPAC taking over the public Intro and Know Before You Go classes. FPAC also had a very successful fundraising season and will be helping with more of the financials of the PAC budget next winter. Mike Beach, previously of Colorado, joined the McCall Ranger District as the Recreation Management Specialist and Acting Director of the PAC. Mike brings a great background of recreation management, is an avid summer and winter recreationist and provided excellent leadership and oversight through his first winter on the job.

Interesting observations included an increase in traffic both skiers, hybrids(sled skiers)and definitely on the purely motorized side with many out of state sledders and snowbikers traveling from areas that were experiencing a low snowpack winter. Also notable were the increase in incidents during periods of lower hazard which seemed like a shift from previous years. This left forecasters struggling to properly message the isolated and pocket-like nature of the hazards.

Most notably was the fact that the Greater West Central Mountains area also had its first winter in quite a few years without a mid-winter, high elevation rain event…which was a legitimate treat! Social media traffic was at an all-time high; several posts were viewed by and shared to more than 20,000 users. Finally, PAC received more observations from the public than in any year prior from locals and visitors alike. That combined with a deep and mostly user friendly snowpack created a most enjoyable and memorable season.

—Dave Bingaman



SAC: An M6.5 earthquake occurred on March 31st at the tail end of a significant spring storm. Widespread avalanches, such as these on Merritt Peak visible from the town of Stanley, occurred as a result. *Photo Tanner Haskins*

SAWTOOTH AVALANCHE CENTER

In south-central Idaho, it seems that historic is the new normal. The previous three winters brought unusual snowpack conditions and historic avalanche cycles. The 2019–20 winter season was no different, with a widespread surface hoar layer and historic deep slab cycle, not to mention a major earthquake and worldwide pandemic.

First, some nuts-and-bolts. The Sawtooth AC nearly doubled our forecast area, expanding to more than two million acres on three National Forests. This was facilitated by a grant from the Idaho Department of Parks and Recreation that covered a fourth full-time forecaster. We launched a fresh website and beta-tested a new avalanche forecasting platform—a national-level project that provides back-end and forward-facing interfaces for creating and displaying avalanche forecasts. This platform will be in use by several avalanche centers in the coming winter.

October snowfall followed by a dry November led to basal depth hoar layers on shaded, upper elevation slopes. Thanksgiving storms brought as much as 30 inches of new snow to the Ketchum/Sun Valley area—unfortunately, this would be the last major storm this area would see until March. A storm on December 7 buried one of the most widespread surface hoar layers we've seen. It was present in nearly every pit dug across the forecast area—spanning a distance of 60 miles. From safe locations and with clear views of the terrain below, one of our forecasters remotely-triggered 13 avalanches on this layer in one day (Friday the 13th, in fact).

In mid-January, the floodgates finally opened as an extended storm cycle pounded much of our area with 2-4+ feet of new snow. The greatest snowfall occurred in our northern mountains, coinciding with the weakest basal facets. Clearing skies at the storm's end revealed numerous five to six-foot thick crowns—the most significant deep slab cycle in the Sawtooth and Banner Summit mountains in recent times.

Unfortunately, this storm cycle also resulted in the first avalanche fatality we've had since 2014. On January 15th, two snowmobilers were riding in the Baker Creek drainage approximately 15 miles from Ketchum. An avalanche triggered from low on the slope caught both riders, burying one three feet deep. He was found by his partner after an estimated 40 minutes but did not survive. The wind-loaded slope failed two feet deep and 200 feet wide on faceted snow near the ground. Since 2004, there have been four avalanche fatalities within a five square mile portion of this drainage.

After an unstable start to the season, including several days of HIGH danger and two

avalanche warnings, the excitement ended in February. High and dry conditions prevailed the entire month, especially in the Ketchum area where less than three inches of snow fell at the Sun Valley Ski area. Our northern mountains fared better, but still received only 40-50% of normal snowfall. By mid to late-February, the entire forecast area was at LOW danger for the first time all season.

Snowfall finally returned during the first part of March. But something less welcome also arrived: Covid-19. Blaine County—home of Ketchum, Sun Valley, and Hailey—was hit early and hard by the virus. The county quickly had the highest number of Covid cases in the state, and the per-capita infection rate surpassed that of New York City. By mid-March, the Sun Valley Ski Resort had closed early and local guide services suspended operations. Our intern hastily returned to his home in Norway before it became impossible.

Backcountry traffic surged as unemployed residents and former resort skiers took to the hills. Due to increased backcountry use and our ability to continue our work while following Covid protocols, the Sawtooth AC remained open until its scheduled closure date on April 12. By and large, the public was supportive, but we received a few comments via social media that implied we were enabling folks to take unnecessary risks or disobey state-issued stay-at-home orders (the orders did not prohibit outdoor recreation). We published a blog post and sent several email newsletters to help our users understand the situation and make appropriate decisions about where and how to recreate in the backcountry.

The increase in backcountry traffic coincided with enticing late-season powder conditions and a persistent slab problem in the upper few feet of the snowpack. Between March 28 and April 4, we had human-triggered avalanches six out of eight days—the highest concentration of triggered slides all season. Several of these qualified as near misses, and we feel fortunate to have avoided an avalanche accident while local emergency services were overwhelmed by the effects of Covid.

As if Covid wasn't enough, on March 31st at 5:52 PM, our world was rocked. Literally. An M6.5 earthquake struck with its epicenter in the northern end of our forecast area, 20 miles from the town of Stanley. Significant in its own right as the second-largest quake on record in Idaho, it coincided with a major spring storm that increased the danger to HIGH. Stanley residents heard avalanches in town—a distance of 3-5 miles from the Sawtooths. When the next morning dawned clear, miles upon miles of crown lines were revealed. These weren't large avalanches—averaging 2-3 feet deep and D1.5-2.5 in size—but there were hundreds of them. Avalanches were less widespread further from the epicenter, but an avalanche attributed to the quake was reported 60 miles away. Look for more details on this rare event at the next ISSW and on page 26 of this issue of TAR.

Our last week of operation was marked by the warmest temperatures of the year and a widespread cycle of wet loose and wet slab activity. Cold temperatures eventually locked up the snowpack and the danger dropped to LOW for the last forecast of the season. As we catch our breath from the fourth straight winter with extraordinary conditions, we find ourselves wondering if "normal" is a word we should remove from our vocabulary.

—*Sawtooth Avalanche Center*

FAC: Whatever your definition of a deep slab avalanche problem, this one counts. Forecasters investigate a 20-foot crown in the Flathead Range. February 2, 2020. The slide failed on a facet/crust structure that formed in October and November, 2019.

FLATHEAD AVALANCHE CENTER

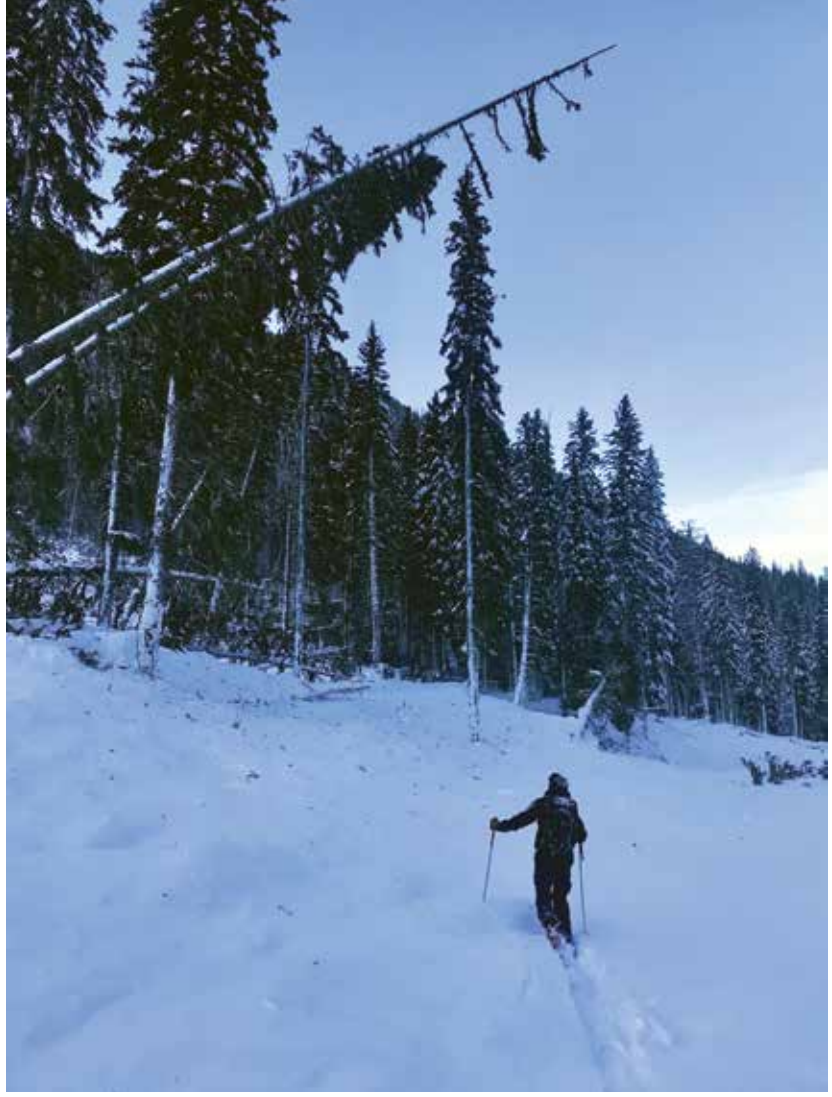
In Northwest Montana, the 2019–20 snowpack was a cagey boxer, feinting, dodging, and disguising its power until mid-January. That's when it landed a knockout punch—a cycle of destructive -in some cases historic—avalanches. The setup for the deep slab cycle was apparent by mid-November, when the basal snowpack on many shady, upper-elevation slopes included a series of ice-hard crusts capped by soft facets. While the structure produced some large natural avalanches early in the season, it mostly withstood large loading events, suggesting that maybe it wouldn't be trouble.

Then came a remarkable seven-week period of sustained snowfall, which brought 18-23 inches of SWE to upper elevation SNOTELs. The unrelenting loading prompted a natural cycle of destructive avalanches in the Flathead Range that ran on weak basal facet-crust structures. These big slides destroyed acres of timber and extended trimlines and paths in what were already large avalanche paths.

A second blow landed during on February 1, when a warm, windy storm brought rain to over 7000 feet and 35 to 75 mph winds that downed trees. It also produced a Royal Flush of avalanche activity: hard slabs, soft slabs, wet slabs, loose, and wet loose avalanches. Many slides entrained wet snow as they ran to lower elevations, making for surprisingly long runouts and deep debris piles. The largest, off of Grant Peak, broke on the early-season facets and crusts, had a 20-foot crown, ran 4000 vertical feet, and deposited debris estimated to be 50 feet deep.

The crust that formed after the February 1 storm capped the snowpack below about 7000

Snowfall and winds continued into mid-February. We added more crusts to our list, including the "Shower with a Friend Day" crust on February 5.



FAC: A FAC forecaster stares in awe at the carnage from an avalanche in January that toppled swaths of mature timber and extended the historic trimline an estimated quarter mile. January 15, 2020.

feet, diminishing the hazard of full-depth avalanches failing on early-season weak layers. But snowfall and winds continued into mid-February, punctuated with more warming and freezing rain events. We added more crusts to our list, including the "Shower with a Friend Day" crust on February 5. The seven weeks of storms finally ended February 18.

While the rest of the season saw drier conditions and mostly surface avalanche problems, several scary near-misses occurred at the start of April, during the peak of Montana's Covid shutdown. These ran on a persistent weak layer formed in the dry weather. Although the near misses all involved groups who are regular customers to the backcountry, we saw a notable uptick in backcountry usage during Montana's Stay-at-Home orders. A large portion of "unconventional" or new use was concentrated at Whitefish Mountain Resort, which had closed its lifts while maintaining an uphill policy. Fortunately, both the terrain and snowpack at the resort were more forgiving than the tricky persistent slab problem that was quite active in other parts of the region.

In Montana's Stay-at-Home directive, the governor stated that "Montanans are discouraged from outdoor recreation activities that pose enhanced risks of injury or could otherwise stress the ability of local first responders to address the Covid-19 emergency (e.g., backcountry skiing in a manner inconsistent with avalanche recommendations or in closed terrain)." Paired with relatively low Covid infection rates and hospitalization numbers in Flathead Valley, our center decided to continue regular operations, with minimal adjustments apart from teleworking and modifying field-bound commuting strategies for volunteers. Our center used our website, social media, and media platforms to message extra caution and more conservative decisions during the last few weeks of our forecast season. The snowpack transitioned to a typical diurnal spring cycle in mid-April as the season wrapped up for FAC

The 2019–20 winter marked the third season of unprecedented growth for the FAC. The total number of observations submitted in the 2019–20 season was 2.7 times what it was in the 2015–16 season (508 vs. 189). Even more importantly, the number of public observations is up nearly threefold (255 vs 87). That increase demonstrates a significantly higher level of engagement by the public with the FAC, as well as a substantial time donation by those who submit reports.

The FAC also issued significantly more products during the 2019–20 season—nearly two times what we did in the 2017 winter (283 vs. 143) for the same length season. We're able to issue more zone-specific forecasts (rather than lumping all three zones into one product) because we receive more observations from the public, have four forecasters in the field collecting data and collaborating on forecast products, and have installed a weather station on the crest of the Swan Range. We've also honed our field practices and forecasting workflow.

The increase in products brought more engagement with our users. Website pageviews have more than doubled since 205, with a 26% increase in total website visits over last season and a 43% spike in unique visitors. Our social media efforts also paid off, exemplified by a 61% increase in Instagram followers and over four times as many people viewing videos on our Facebook page (nearly 108,000 total views). The growth demonstrates increased engagement from our audience and an improvement in avalanche products—both the result of investment from our agencies and partners and the legwork from FOFAC and the USFS to transition the FAC to a Type 1 Avalanche Center six years ago.

It's also due in very large part to over three years of indefatigable efforts by Director Zach Guy. His vision and energy have helped convince the FAC's key stakeholders to intensify their fundraising efforts or invest in the organization. Their contributions have paid off with advances in forecasting practices, new funding partners, and a stable, capable staff, as well as new website tools, new weather stations, and new snowmobiles. Graphs of nearly every metric for the avalanche center shows a distinct nick point at the start of his tenure, with sharp climbs over the next few years. Sadly for the Flathead Valley, Zach has decided to return to his native Colorado. No, the bush hasn't beaten him. But we will miss him.

—Blase Reardon, FAC Lead Forecaster

GALLATIN NATIONAL FOREST AVALANCHE CENTER

In the Rocky Mountains early season snow is typically not good for stability. In southwest Montana, this year was on the worse end of the spectrum for bad stability caused by early season snow. Weak snow near the base of the snowpack resulted in large avalanches all season. The poor snowpack structure prompted months of strongly worded forecasts with phrases such as, "*Avoid avalanche terrain… Avoid heavily wind loaded slopes… Multiple tracks can cross a slope before one finds the weak spot… A conservative mindset is essential… Big objectives should wait… Think carefully about the terrain you plan to ride… Come home alive.*"

Avalanche activity peaked with a widespread deep slab avalanche cycle in February. More snow followed and there was steady avalanche activity through May. For the first winter since 2012–13 there were zero avalanche fatalities in southwest Montana.

On September 21 the first 9" of snow was enough to create small wet loose avalanches when the sun came out. By November settled snow depth was 1-3'. The mountains got 1-2' of snow to start November which was followed by dry, warm weather through Thanksgiving. The shallow snowpack became weak and faceted with various crusts.

We began daily forecasts on November 30. The mountains got 2-4 feet of snow over the first couple weeks of December, then were mostly dry until the New Year. During the second half of December avalanche danger was Low in the mountains near Bozeman and Moderate elsewhere. Near West Yellowstone heavy snow on Christmas Day spiked danger to High for a day. To start 2020, the mountains throughout our area received steady snowfall which brought danger to High and Considerable on January 2.

Through January 9 there had been six days with High danger somewhere, and 15 days with Low danger in the mountains near Bozeman. Near West Yellowstone, Big Sky and Cooke City danger was at least Moderate every day through mid-February (except one day with Low danger near Cooke City).

Storms from January 1 to January 20 increased the snowpack's total snow water equivalent (SWE) by 50-80%. Loading events were relatively small and followed by steady wind. This prevented slopes from breaking all at once in a widespread natural avalanche cycle, but kept weak layers sensitive to human triggers and maintained heightened avalanche danger.

We saw three snowmobile-triggered avalanches with crowns 10-15 feet deep during the first half of January. There were more than 50 avalanches reported over the first 20 days of 2020. There were eventually fewer warning signs like collapsing or natural avalanches, but the snowpack structure remained poor and human-triggered avalanches continued to break deeper and larger. Most avalanches were triggered on persistent weak layers near the ground and on heavily wind loaded slopes. The biggest were on slopes where snow from many small storms was drifted into thick slabs by strong southwesterly winds.

We issued our first and only avalanche warning of the season on February 6 and 7 at the start of a storm that dropped 3–4 feet of snow equal to 3–4" of SWE over four days. Danger was high near Bozeman and Big Sky through February 10. Snow and wind continued the following week and a widespread deep-slab avalanche cycle occurred in the Bridger Range, Hyalite, and near Big Sky. From February 6–18 we recorded 98 avalanches. Danger dropped to Low near West Yellowstone on February 18, and near Bozeman and Big Sky remained Considerable or Moderate until March 9.

On February 27 a snowcat grooming a trail between Bozeman and Big Sky triggered a slide which rolled and badly damaged the vehicle with no serious injury to the operator. The avalanche broke on weak, sugary snow on the ground, and was on a low elevation slope (7800', W aspect) with a relatively shallow, 2–4 foot deep snowpack.

Through March, avalanches mostly involved snow from recent storms, and at the end of the month a crust/facet/surface hoar persistent weak layer buried 2–3 feet deep was reactive for a few weeks. Shallow wet snow and new snow avalanche activity occurred through mid-May. Then, extended above freezing temperatures arrived in full force and induced deeper wet slab avalanches. On May 19th, within the boundaries of the closed for the season Yellowstone Club, a very large natural wet slab broke thousands of feet wide on the weak layer at the base of the snowpack, WS-N-R4-D3.5-O.

At the end of the season we faced the many challenges presented by the Covid-19 pandemic. Our Forest remained open and as forecasters we were deemed essential to continue public safety messaging. We stopped using volunteers as field partners and only went out with each other. There was increased backcountry use due to ski areas closing early and people with more free time. Avalanche bulletins were critical to promote conservative travel advice and basic avalanche awareness.

Some non-snowpack highlights include Dave Zinn joining our team as a part-time forecaster. He will return in full time capacity next winter. Additionally, 32 volunteers and our intern Spencer Jonas partnered with us in the field when we were not out with each other. We worked with the Friends of the Avalanche Center and their 42 instructors to teach 125 classes reaching 4,240 people. Most classes were 1-hour Avalanche Awareness, Companion Rescue, and Introduction to Avalanches with a Field Session. This was the 4th year of our weekly Cooke City program of Friday night awareness talks and Saturday hands-on rescue practice, and the fourth year with zero snowmobiler fatalities near Cooke City.

—Alex Marienthal

GNFAC: Alex Marienthal stands below the crown of a very large snowmobile triggered slide near Big Sky on January 4th. During the first half of January we saw three snowmobile triggered avalanches with crowns 10–15 feet deep. *Photo GNFAC*

BRIDGER-TETON NATIONAL FOREST AVALANCHE CENTER

BTAC: Lucky dog, January in the Tetons. *Photo Dan Powers*

The avalanche hazard in Western Wyoming went through three phases during the 2019–20 season.

The first phase was comprised of the formation of a persistent weak layer (PWL) and the management of avalanche hazards on that layer. Record cold temperatures and dry periods transitioned a shallow, early season snowfall into layers of faceted snow and crusts. When more snow arrived in late November and December, backcountry users encountered a persistent slab avalanche problem. Close calls were part of that landscape.

The second phase occurred during the 48-day period from January 1 through February 17 when record snowfall occurred at the Rendezvous Bowl Snow Study Plot: 253 inches of snow with 22 inches of snow water equivalent (SWE). This extended storm cycle buried the PWL so deep that it was no longer a problem. During this period the avalanche hazard transitioned from a persistent slab to a deep persistent slab to slabs of various depths that only involved storm snow. This phenomenon occurred sooner, with larger slab sizes and depths, in areas that received the most snow. Those areas included the higher elevations of the southern Teton Range. Outlying areas that received significantly lower amounts of snow retained some persistent slab hazard at the end of this stage. Those outliers were on the east side of the Continental Divide in the Togwotee Pass area, the Upper Green River Drainage, and along the east slope of the Wyoming Range.

During the third phase, avalanche hazards were limited to new storm events.

The management of the avalanche hazard was more complex with higher consequences during the second phase. During this extended storm cycle forecasters monitored avalanche event attributes and tracked 1, 3, 5 and 10-day cumulative SWE totals to help forecast increases and decreases in the persistent, deep persistent and storm cycle slab avalanche risk.

The season ended with snowfall totals that ranged from 400 to 600 inches in the high country. After a relatively dry spring, SWE totals at the end of May were 117 percent of the 30-year median at Snotel sites in the forecast region. Daily mean temperatures were 3 to 6 degrees warmer than average in December and January and 1 to 3 degrees cooler than average in February and March.

Due to the late onset of significant snow, daily avalanche hazard bulletins did not begin until late November. The last daily avalanche hazard bulletins were issued on April 25. Twenty-four-hour summaries of data from our network of remote weather stations were posted daily from October 1 through June 18. Weekly snowpack summaries were posted from the end of September through May. Backcountry trailheads were extremely busy with local skiers and riders from mid-March through April due to the coronavirus pandemic.

There were 25 people who were caught and carried in avalanches. Seven of those people were partially buried and four were fully buried. Two did not survive. Trace Carrillo was a seasonal wilderness ranger with the Forest Service and a former intern with the Utah Avalanche Center. He died on April 1 while backcountry skiing on Mt. Taylor. Rob Kincaid was a professional snowmobiler who died in the Snake River

Range on April 3. Both were local, experienced professionals who were advocates for avalanche safety. Both were fully buried wearing avalanche transceivers that were functional but had not been turned on.

Several new features were available on our website during the 2019–20 winter season. A radial plot of avalanche events was added to the website. This tool graphically displays the aspect, elevation, size, and depths of avalanche events. It includes a date range slider bar and can display avalanche events for the date range selected for avalanches that occurred during any of the past ten seasons. Viewing options allow the user to sort the displayed events by avalanche type, trigger and forecast area.

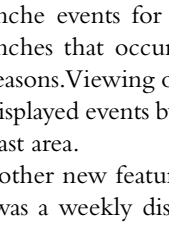
Another new feature that also debuted this season was a weekly discussion of weather and avalanche conditions in Grand Teton National Park. This product was written by Lisa Van Sciver and supplemented our weekly snowpack summaries. Website programming upgrades were also added that enabled the public to upload photos and videos to avalanche observations, field observations and snowpit profiles. Technology was also added to the avalanche event display section of the website that allows avalanche forecasters to display avalanche events as polygons instead of a point.

This was the second season that our center has partnered with Grand Teton National Park to increase the quality of our avalanche hazard forecasting program. These efforts are financially supported by donations to the park from the Grand Teton National Park Foundation.

Our partnership with the Wyoming State Trails Program has been ongoing since 2001. Funding from their program increased our field presence and allowed the center to host avalanche education courses in the communities of Rock Springs, Cody (jointly with the Gallatin National Forest Avalanche Center), Sheridan, Afton, Lander and to outfitters permitted to guide in avalanche terrain on the National Forest. Nearly 600 people attended these classes.

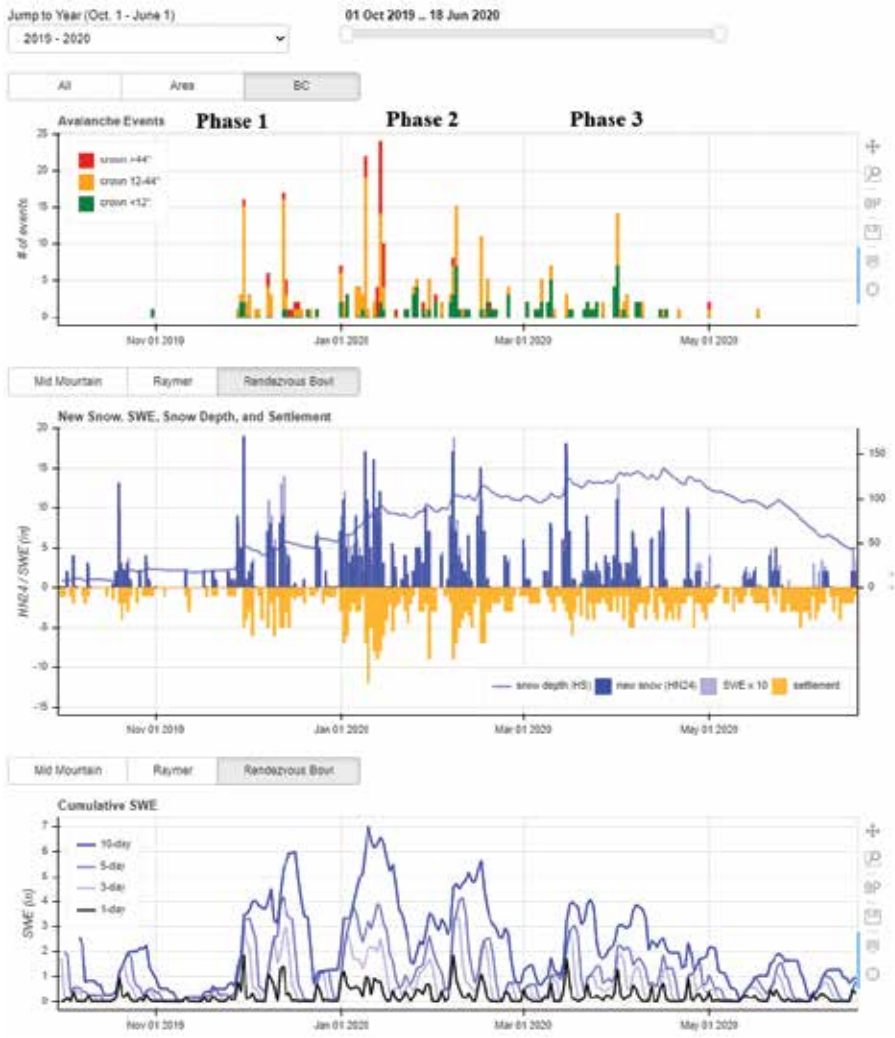
In May the board of directors of our non-profit support organization, Friends of the Bridger-Teton Avalanche Center, voted to change its name to the Bridger-Teton Avalanche Center Foundation.

—Bob Comey



UTAH AVALANCHE CENTER

Like many seasons, late fall and early winter snowfall in Utah created a persistent weak layer at the ground in the mountains of northern Utah. This weak layer existed on the shady, north-facing slopes and kept most backcountry skiers and riders on their toes. This troublesome layer gradually became dormant and unreactive by the end of December into early January, and backcountry riders enjoyed some of Utah's finest powder and generally stable conditions for a few weeks. A similar layer formed in central Utah, but it was never overloaded. Further south near Moab, the snowpack was generally deep and strong through January. In that area, a dry February weakened the snowpack which then produced many avalanches when snowfall returned in March.



BTAC: This graph provides daily totals of a variety of parameters for the period from October 1, 2019 through June 18, 2020 on the horizontal axis. The upper panel displays the number of backcountry avalanches reported on each of those days. Those avalanche events are color coded according to crown depth. The middle panel provides snowfall data from the Rendezvous Bowl Snow Study Plot. That data includes snow height (blue line), 24-hour new snowfall (dark blue bars), 24-hour SWE (light blue bars) and 24-hour snow settlement (yellow bars). The lower panel graphs 1, 3, 5 and 10-day cumulative SWE totals from the Rendezvous Bowl site. The characteristics of this season's avalanche hazard went through three phases. The first phase (October 1 to December 31) involved the development and shallow burial of a persistent weak layer. Record snowfall deeply buried that layer during the second phase (January 1 through February 17). Avalanche hazards were almost entirely limited to recent new snow during the third phase (February 18 through June 18).

UAC: Trent Meisenheimer performs an extended column test on a field day in Big Cottonwood Canyon. *Photo UAC volunteer staff*

During a 12-month period from January 2019 to January 2020, six people died in avalanches in Utah. In all of these tragic events, the people involved were lacking critical pieces of avalanche rescue gear.

UAC: Mark Staples looks at a fatal avalanche in Farmington Canyon that killed a snowmobiler on January 19th. *Photo Trent Meisenheimer*

A very interesting weak layer formed in the mountains of northern Utah in January and presented a unique challenge. Our common pattern usually sees unstable north-facing slopes with a basal weak layer, while south facing slopes had stable snow. Seemingly overnight the situation reversed. The right combination of cold temperatures and just a little bit of sunshine created an ice crust with a weak layer of faceted snow adjacent to it. New snow on this crust/facet layer created a setup where numerous natural and human triggered avalanches occurred. What was unique is that this new layer formed on south-facing slopes that had previously been stable The north-facing slopes that had previously been dangerous became less reactive. It was a challenge for users to adjust to this new pattern. It was a challenge for our forecasting staff to understand the situation and then communicate it to the public.

A notable storm occurred February 5th-7th and wreaked havoc in Little Cottonwood Canyon. A nearly 50-hour period brought both sustained snowfall and westerly winds with the bull's-eye on upper Little Cottonwood Canyon. Snow fell at a rapid rate of ½ to 1 inches of snow per hour for most of the 50 hours. This may be the longest sustained snow and wind in recorded history for Alta. The storm produced 30"-41" of snow (5.52"—6.79" water) averaging 16% density (7-8% is normal) and led to numerous natural, human, and explosive triggered avalanches. Over 20 avalanches crossed the Little Cottonwood Canyon road which was closed for 54 hours. Miraculously no one was reportedly injured during that time.

As ski resorts shut down prematurely this spring, it seemed snowfall shut down as well with the driest April in the last 20 years. There were two notable storms in March and April with two cycles of human triggered avalanches. The main reason was the combination of more people in the backcountry, fresh powder after a dry period, and sensitive storm snow on top of a faceted layer on some slopes. During the cycle in April, there were 50 reported human triggered slides in 48 hours. Luckily no one was seriously injured or killed. One skier tracking himself recorded traveling 77 mph when he was caught in a slide on Mt. Superior in Little Cottonwood Canyon.

Unfortunately, there were two fatalities this season. The first avalanche fatality occurred on December 15th in the backcountry area of Dutch Draw near Park City after 18" of snow had fallen. The second avalanche fatality occurred on January 18th in the Farmington Lakes area above Farmington Canyon.

A note about recent avalanche fatalities in Utah: During a 12-month period from January 2019 to January 2020, six people died in avalanches in Utah. In all of these tragic events, the people involved were lacking critical pieces of avalanche rescue gear. Seeing people venture into the backcountry without avalanche rescue gear or knowledge is nothing new, but having this issue be a factor in the last six fatalities is striking. We continue working to find new ways to reach people including launching a new trailhead outreach program for this coming winter.

Despite shutdowns in response to coronavirus, the UAC continued issuing regular avalanche forecasts through late April with no interruptions in service. There was some question of whether we could or should continue issuing avalanche forecasts. After consultations internally and with federal, state, and county agencies, we made the decision to continue. These forecasts were needed more than ever as trailheads were busier than anyone had ever seen them. We worked from home and made some alterations to our field operations but were able to continue monitoring the snowpack safely and effectively.

In terms of staffing, Evelyn Lees retired in December after an amazing 28-year career at the UAC. Evelyn has been the foundation for avalanche forecasting in the Salt Lake office since her arrival in 1991 and her impact at the UAC is immeasurable. She has been a mentor to all our staff including our newest forecaster this fall. Evelyn's impact upon the broader backcountry community is also immeasurable. We were sad to see her leave but excited for all the travel and fun things she had planned for retirement. We hired a new forecaster, Nikki Champion, in November and are really happy to have her on board. The UAC also hired Hannah Whitney as our first Development Director and brought past intern and contractor Andrew Nassetta onto the staff to coordinate the KBYG program, manage the trailhead signs, and teach our on-snow classes.

Overall it was a very successful winter. The Utah legislature designed the first week of every December to be Avalanche Awareness Week, and it was a huge success in its first year. A few numbers:

- 6,882 people received education from the UAC (55% were kids)
- 34 on-snow classes
- 117 Know Before You Go presentations to 117 groups
- 1,197 avalanche forecasts
- 449 field days.
- 2 avalanche awareness programs for all US Ski and Snowboard team coaches and athletes
- 242 videos with 2.1 million views
- 23% increase in social media followings

Next winter holds many uncertainties. However, we know that there will be snow, avalanches, and many people venturing into the backcountry. We suspect there will be more people recreating in the backcountry than ever. We have a busy summer determining how to host fundraisers, hold events, and deliver programs like the Utah Snow and Avalanche Workshop virtually. We are developing a new trailhead avalanche awareness program and working closely with ski resorts and retailers on how we can reach more users with basic avalanche awareness information.

We are incredibly grateful for the amazing financial support of the backcountry community, local businesses, and state and federal programs. Without this support, the UAC would not be able to provide the forecasting, awareness, and education programs that the community relies on. Thank you to everyone who provided support this season. Full annual report available at https://bit.ly/uac-202-annualreport.

—Written by UAC staff, compiled by Mark Staples

MOUNT SHASTA AVALANCHE CENTER

MSAC: December 31st, 2019—The widespread slide-for-life yet punchy, and might I add, straight-up gnarly ice crust left behind by the wet and warm December storms.

The U.S. Forest Service Mount Shasta Avalanche Center finished its 22nd season of operation. Some might reference last winter as a poop sandwich, as it was characterized by below-average precipitation with February checking in with only 0.12 inches of water recorded. It was the driest February on record, the prior record being set in 1971 with 0.21 inches. The wet season began just before Thanksgiving when a "bomb cyclone" blasted in from the north bringing 22 inches of snow and shutting down highways to holiday travelers. Several additional storms came in December, bringing nearly five inches of water, unfortunately with warm temperatures and forming a very stout ice crust. Regular storms continued to come in January and cold temperatures brought precipitation as snow to lower elevations. The relatively shallow snowpack, crust layers, and cold temperatures led to a persistent weak layer forming in the upper snowpack. This is somewhat unusual for our climate and led to some lively discussions and in-depth snowpack analysis. February, if you did not figure already, was poop. Though we made some gains in late March and early April, they did not provide the miracle needed to get us back on track. April did bring one unusually cold storm that produced two inches of precipitable water and 22 inches of snow. Snow levels dropped below 3,000 ft. This storm and wind events during and shortly after led to several skier-triggered and natural avalanches.

Avalanches were not a common occurrence this season due to below-average precipitation. We embarrassingly only recorded 11 avalanches within our forecast area. Of these, the largest D3 avalanche occurred on the east facing aspect of Casaval Ridge after the April snow/wind event deposited new storm snow along the ridge. The slab that released was ½ mile long and deposited snow up to 10 feet deep in climber's gully below. Avalanche Gulch and Gray Butte produced most observed avalanches. Despite one partial burial of a backcountry snowboarder, the Mount Shasta Avalanche Center is happy to report that no one was injured or killed in an avalanche within our forecast area during the 2019–20 winter.

By the numbers, during the wet season (October–April) Mount Shasta City received 17.17 inches of water which is 47% of the historic average of 36.68 inches. Snow surveys completed in April also revealed the region's snowpack near half (53%) the historical average and contained 45% of the normal water content. From November 26th, 2019 through April 12th, 2020, the Old Ski Bowl (treeline) on Mount Shasta received 220 inches of snow. The snow water equivalent (SWE) measured was 21.28 inches. The maximum snowfall in 24 hours was 22 inches. The maximum average wind recorded was 56 mph and the maximum wind gust was 80 mph. Temperatures averaged 29 °F. The minimum and maximum recorded were 6.5 °F and 55 °F, respectively.

For the 4th season in a row, the MSAC had three full-time employees. Nick Meyers returned for his 11th season as director and forecaster and 18th season as a climbing ranger. Aaron Beverly worked his fourth season as a professional observer and forecaster. Ryan Sorenson worked his second season as an avalanche forecaster and climbing ranger. The Friends (FMSAC) group is the Center's nonprofit that was formed in 2002 and is an essential component of the Avalanche Center. The USFS funds the forecasters' salaries, while the Friends of the Mount Shasta Avalanche funds the professional observer's salary. The Shasta Trinity National Forest funded 52% of the MSAC's total operating costs for the 2019–20 season. The MSAC was awarded a CA state OHV grant that provided 31% of the total funding for this season, and the FMSAC funded 17%. The FMSAC is a volunteer group with one paid position, Executive Director, Justi Hansen. The group represents the soul of adventure and passion for backcountry mountain recreation in the greater Mount Shasta area. We extend a huge thank you for all their effort and support.

The MSAC website experienced steady use this season. For the winter, www.shastaavalanche.org received 75,199 total visits (+17%), of which 27,969 (+22%) were unique users. The average session duration was 2 minutes and 28 seconds. Of website visitors, 24% were returning while 76% were new. Instagram followers increased by 315% to 2,326. Facebook followers increased by 31% to 5,546.

The Mount Shasta Avalanche Center delivered 15 KBYG avalanche presentations this season reaching 181 people throughout northern California and southern Oregon. The MSAC provided free avalanche awareness and companion rescue clinics the first Friday and Saturday of December, January, February, and March in Mount Shasta City. A training was also given to elementary and middle school kids at the Northern United Charter School. There were also two internal Forest Service employee avalanche awareness and companion rescue workshops.

For the end of the season, typified by the Corona virus, the MSAC remained in operation under the direction of local and regional Forest Service leadership, who deemed our operations as essential service/public health and safety. For the MSAC and the rural area for which we provide avalanche safety information, operations changed little. Local trailheads remained open. We closed the doors for the season on April 12th and rolled right into spring climbing season on Mount Shasta. Late April, May, and June are the busiest time of the year for the mountain. The Forest Service issued a closure order for all terrain above 10,000 feet within the Mount Shasta Wilderness on April 24th. The closure, before and during, brought keyboard-smashing zealots out of the woodwork for both sides of the issue on the social platforms. Many used the pandemic to fuel extreme localism. Our thoughts go out to all of those affected by the terrible virus.

It was a bit of a funky season but the MSAC weathered well. Friends fundraisers were extremely successful, daily operations remained normal, forecasters stayed healthy, and all will continue next winter!

—Nick Meyers and Aaron Beverly

TAHOE NATIONAL FOREST SIERRA AVALANCHE CENTER

DRIEST FEBRUARY ON RECORD, THEN STORM DOOR OPENS FOR COVID-19 SHUTDOWN

While other regions around the West began getting early season snow in the fall, the Central Sierra Nevada was experiencing another warm and dry season that extended to the end of November. An end to fire season arrived with a storm that was followed by active weather with near normal snowfall through most of December. As January arrived, storms began to decrease, allowing a crust/facet layer to form and become buried in early January. A storm just before MLK weekend brought 2' of snow and 1.5" of SWE. Multiple persistent slab avalanches occurred on this layer; one was a skier triggered 1000' slide resulting in a 45-minute burial and a live recovery near Independence Lake. After some additional unsettled weather in January, high pressure built in and stayed through all of February and into mid-March. February went down as the driest month on record with most remote sensors reporting no precipitation.

As the storm door finally decided to open again for the Sierra Nevada, the Covid-19 pandemic was in full swing. The state of CA enacted shelter in place orders, closed schools, and ski resorts closed on March 15. This coincided with one of our first big storms of the spring season. Our local backcountry areas changed overnight. Large numbers of new users, tourists, and current backcountry enthusiasts all went out in search of new snow. As use skyrocketed, the type of users changed. Many of these new folks had little to no previous backcountry experience. Local gear shops sold out of most of their gear in a brief period before they too had to shut down. Messaging became even more important as our "average user" was less educated and experienced. Out of 134 reported avalanches for the season, 76 of these occurred after the shelter in place orders were announced; 12 out of the 16 reported avalanche incidents occurred during this same period. We feel extremely fortunate that we made it through the shutdown without any fatalities or critical injuries.

We had four distinct avalanche cycles after the start of the Covid-19 closures on March 15. A deep slab issue developed immediately with a storm cycle dumping 3-5' of snow with 5—6" of SWE over a three-day period, deposited onto a weak faceted snow/crust combination developed during our record setting dry February.

A late season buried surface hoar event occurred on March 25. It's rare for our area to have surface hoar form and become buried this late in the season. This layer was responsible for numerous human-triggered and natural avalanches. We had another facet/crust combination persistent slab avalanche problem in early April. Once warm spring weather began in earnest, our buried surface layer became a wet slab issue. Several wet slab avalanches occurred over a one-week period in mid to late April.

SAC: A skier-triggered deep slab avalanche at Independence Lake on January 17 resulted in a 1000-foot ride with full burial. An air bag was deployed, gear was lost, and the 45-minute burial ended with a live recovery. *Photo SAC Public*

The Tahoe National Forest, home of the Sierra Avalanche Center, along with the four other National Forests where we operate, decided to remain open. Specific large trailheads were closed with some limitations on travel established within different counties and jurisdictions. The Sierra Avalanche Center continued working with daily forecasts and field observations as directed by our USFS Regional Office in the name of Mission Critical Public Health and Safety. Due to the increased backcountry use, we decided to extend our closing date by a couple weeks into the beginning of May. As forecasters, we implemented a series of Covid-19 protocols to reduce our exposure. Before the state closures were announced, we moved out of our FS office and began to conduct all office work from home. We started driving separate FS vehicles to the trailheads, and we canceled our FS volunteer observer program. We practiced normal social distancing procedures while in the field and at the trailhead. All of SAC's education, outreach, and fundraising events were also canceled for the remainder of the season.

Operations and personnel at the Sierra Avalanche Center this past winter remained consistent with previous years. Director/lead forecaster Brandon Schwartz along with Andy Anderson and Steve Reynaud served as avalanche forecasters. Travis Feist continues as a professional observer and Education Coordinator and David Reichel continues as a professional observer and Social Media Coordinator. SAC issued 156 daily avalanche advisories and three early season snow condition reports.

The Sierra Avalanche Center functions as a partnership between the Tahoe National Forest and a volunteer Board of Directors with 501(c)(3) non-profit organization status. Mark O'Geen continues as Executive Director for his third term along with Mark Bunge as SAC Board President. The SAC board continues with momentum in securing financial support for our organization. SAC continued their ongoing scholarship program awarding $16k to help local user groups access avalanche education. Both our human powered and motorized outreach education programs continue to grow and be well received. Our motorized outreach programs continue to thrive with the funding from a CA OHV grant for snowmobile specific avalanche education including six level 1 avalanche courses and two rescue courses. The non-profit SAC and the Tahoe National Forest continue to work together successfully to provide funding and operational support for the Central Sierra Nevada community.

—Steve Reynaud

EASTERN SIERRA AVALANCHE CENTER

Last year the Sierra Nevada was one of *the* places to be with record setting snowfall, but this winter it came in last place compared to most other mountain ranges across the country. There were only two storms of note during all of January and February, which collectively dropped less than a foot of snow. The high-country was decimated by high winds during much of this time, and more decomposed granite was laid down than wind slab. Forty-five days of LOW danger were posted during this two month dry period, compared to 10 LOW days for the entire previous season. "LOW doesn't mean NO" became our common refrain.

The season did, however, have a great start with a week-long storm cycle on Thanksgiving that dropped nearly 6" of SWE and over 70" of snow. This base combined with some moderate December snowfall would carry the Eastern Sierra through the drought until Ullr, the snow

god, would show some compassion and crack open the faucets again in March and April… just in time for the Coronavirus. The storm track finally lined up, dumping over 3 feet of snow and 3.5" of SWE between March 15–17, just as the local lift services to Mammoth and June Mountains shut down. Backcountry use exploded like never before in this area. One trail counter to Mammoth's backyard backcountry spot, the Sherwins, recorded over 200 people in a single day. The local backcountry gear shop had record sales, and fortunately, despite a few predictable wind slabs being triggered by skiers, no actual incidents occurred.

The best skiing of the year continued through March, with barely a day going by without at least a couple of inches of new snow falling. Eighty-four inches of total snowfall and over 7" of SWE were recorded for the month. But the conversation surrounding Covid overshadowed the sweet skiing conditions. First came the California Governor's Stay-At-Home order on March 19. Two days later, fueled by increasing pressures from local healthcare providers and first responders, the Inyo County Sheriff's Department, one of the two counties that ESAC forecasts cover, posted a request to avoid "high risk" activities, including backcountry skiing. While this wasn't a hard and fast order, ESAC felt it should comply and support this request by discontinuing field and forecasting operations for areas within that county.

The ESAC board of directors and forecasters held lengthy conference calls almost daily to discuss shifts in operation and how to produce balanced messages that encouraged minimizing risk while not condemning backcountry travel. Forecasters were limited to travel within 1.5 hours of trailheads. After the second county in ESAC's forecast area, Mono, identified backcountry skiing as a risky activity to avoid, ESAC ceased operations and issued its final advisory of the season on April 1st. Knowing that some people would still be traveling in avalanche terrain, this was a hard and controversial decision for ESAC. It was finally decided that the message conveyed through halting advisories outweighed the benefit for decision-making that further advisories would provide for those who continued to ski in the backcountry. The potential consequences of a forecaster getting hurt during this time, both for the forecaster and the strain this would add to the small health care system in the Eastern Sierra, was a significant factor in this decision.

While the backcountry still saw travelers after this, the numbers did seem to diminish as the flurry of social media posts turned from enthusiastically documenting backcountry fun to "I've hung up my skis, perhaps you should too."

Of course, on the heels of ESAC's shutdown came the most intense storm of the season, dropping over 50" of snow in five days, with three feet of snow and 3.3" SWE in one 24-hour period beginning April 6. When the skies cleared, some of the largest crowns of the season were revealed, and on the first significant warm-up after the storm, on April 11th, the first true avalanche incident of the season occurred. A snowboarder riding in extreme terrain triggered a warming slab that released way above him and buried him to his neck. With the help of his partner and perhaps some "divine intervention," the party made it out on their own.

The second reported incident of the season occurred on April 29, when two skiers climbed a NE-facing gully after a poor refreeze, and a D2.5, R3 slab released above them. One managed to self arrest on the edge, while the other was taken for ~1,000' before coming to rest with broken vertebrae and ribs, necessitating a helicopter evacuation. The social media response to avalanches can be harsh and judgmental during normal times, but during the times of Covid Stay-At-Home orders, it was especially so, with comments such as "leave them out there and find their bodies in the summer." As humans we all make poor decisions and mistakes at times. ESAC pushed details of these incidents out through its social media channels, while reminding the public to keep these channels safe for people to be vulnerable and share their errors so others can learn.

In terms of forecasting, the trickiest part of the season occurred at the end of January, in the middle of the long dry period as multiple parties began experiencing collapses on a thin and degrading snowpack. Widespread propagating test results were more common as facet/crust combinations became more and more developed. Despite no actual avalanches occurring, forecasters added a Persistent Slab problem to the advisory on January 25th, and after five days, as confidence grew, the problem was dropped. However, these dormant buried weak layers likely played a part in the surprising number of large wet slabs that released during this spring's unusually active natural wet slide cycles.

ESAC is pleased to say that as of May 11th, no avalanche fatalities occurred this season in the Eastern Sierra.

—Chris Engelhardt, Steve Mace, & Josh Feinberg

ESAC: Naturally triggered D2.5, R3 wet slab avalanche that released above two skiers on April 29 in the NE gully of Independence Peak. It resulted in one person being carried 1000 feet, ending with a broken vertebrae and a helicopter evacuation. The crown is circled.
Photo courtesy Inyo County SAR

COLORADO AVALANCHE INFORMATION CENTER

There were 3900 avalanches reported to the Colorado Avalanche Information Center (CAIC) during the 2019–2020 avalanche season. We documented 85 incidents, with 96 people caught in avalanches. Six people were killed, which matches the 10-year average. The number of involvements exceeds what we recorded in recent years. For comparison, we recorded an average of 58 incidents and 80 people caught in avalanches per season going back to 2012.

Snow began to accumulate in the second week of October, and several more storms through the end of the month created "excellent for October" conditions. The CAIC recorded six small natural avalanches in the Northern and Central Mountains before we got to November. Then the snow spigot shut off.

November began with almost three weeks of dry, mild weather. The snow that lasted through the dry spell on high-elevation north and east-facing slopes changed into well-developed depth hoar. This became the poor foundation upon which we would build the rest of the season's snowpack. Snowpack characteristics were similar statewide, other than more melting in the San Juan Mountains.

Snowfall starting November 20 brought an end to the dry weather, and a corresponding uptick in avalanche activity across the state. Most avalanches ran on higher-elevation north and east-facing slopes and most broke into the depth hoar. With a shallow snowpack most avalanches were small, but the pattern was a sign of things to come. Our

first recorded incident of the season occurred on November 22, when a backcountry tourer was caught and partially buried near Jones Pass. A few more close calls, including an in-bounds, closed out the month.

Five healthy storms during December pushed the Snow Water Equivalent (SWE) to over 100% of the long-term median across all of Colorado's river basins. Each storm event spurred avalanche activity breaking on persistent weak layers, with many avalanches triggered remotely. On December 8, a backcountry skier was caught, buried, and unfortunately killed on the Diamond Peaks near Cameron Pass. The basal weak layers in thin snowpack areas continued to plague us every time we got big storms.

January had light and fairly continuous snowfall, characterized by small to medium sized snow storms, interspersed with short dry spells. Crusts and weak layers formed in the upper snowpack during these dry spells. Each loading event with more than a few inches of snow spurred some avalanche activity. The month also saw several very strong wind events, that dramatically altered the alpine landscape and redistributed snow in many areas.

Twenty-three people were caught in avalanches during the month, including 11 people in one week between January 18 and January 25. Five people were partially buried, three were injured, and tragically, one person lost their life when they were hit with a mix of falling ice and snow. This was the second avalanche fatality in Colorado of the 2019–2020 season.

Persistent northwest flow brought consistent snowfall to the Northern Mountains and parts of the Central Mountains in February. Each loading event again spurred an avalanche cycle. An atmospheric river took aim at Colorado on February 6. This storm was one of the most intense 48-hour periods in recent memory with almost three-inches of SWE in 24 hours at favored locations in the Northern Mountains.

The next big storm arrived for Valentine's Day. On February 15, three motorized snowbikers north of Vail triggered a hard slab avalanche. All three riders were caught in the avalanche and two were fully buried and killed. These were the third and fourth avalanche fatalities in Colorado for the season, and the third and fourth snowbiker deaths in Colorado since 2016.

For the second year in a row, March turned into an exceptional month in Colorado. The Covid-19 pandemic had little impact on avalanches, but did have a huge impact on Colorado communities and outdoor recreation. The human impacts of the pandemic arrived as avalanche conditions changed, and the confluence led to an interesting series of avalanche involvements and discussions about backcountry travel and rescuer's risk.

The CAIC documented 25 people caught in 23 separate avalanches throughout the month. This included two backcountry snowboarders who triggered a small avalanche above the Eisenhower Johnson Memorial Tunnels. As the avalanche ran downhill, it broke into deeper weak layers and eventually to the ground, leaving debris piled 20 feet deep over the tunnel access roads. This was a sobering illustration of the increasing risk of other parties recreating around and above people and infrastructure.

Two backcountry riders were seriously injured in separate incidents in the San Juan Mountains, requiring Search and Rescue assistance against the backdrop of the coronavirus pandemic. The rescues highlighted the need for SAR volunteers to take additional precautions to minimize coronavirus exposure. The incidents also highlighted the increased need for backcountry travelers to consider their potential impacts on others. The CAIC focuses on avalanches and encourages backcountry tourers to consider the consequences of an avalanche. But with increased backcountry use and a rapidly changing societal response to the coronavirus, avalanches were just a portion of a larger discussion of risk and exposure.

CAIC: This avalanche was remotely triggered from flat terrain on Red Mountain Pass on the last day of November. Avalanches like these gave us a good indication of how December would unfold. *Photo courtesy Elizabeth Schwab*

CAIC: An aerial image of the upper portion of The Dungeon ice climb near Ouray on January 20, 2020, two days after the fatal avalanche accident. A large chunk of ice broke away from the hanging pillar and triggered a small loose-snow avalanche on the rock slab below. *Photo CAIC*

Temperatures and strong spring solar radiation played a major role in the number and type of avalanches in April. As people clamored for outside activity, backcountry areas continued to see heavy use, including many people engaging in backcountry travel in avalanche terrain for the first time with newly purchased gear. The CAIC documented 12 people caught in 83 human-triggered avalanches throughout the month.

Unfortunately, there were also two fatal accidents involving experienced backcountry skiers. On April 15, riders unintentionally triggered a relatively small avalanche on Red Peak in the Gore Range that swept one rider down a long, rocky, narrow couloir. On April 28, a backcountry skier was caught and killed in a wet slab avalanche on a steep slope northwest of Crested Butte.

Warm spring conditions lasted through May. We saw continued heavy use in the backcountry, but generally stable avalanche conditions meant only a few incidents in steep terrain, including a hiker who was partially buried and injured in a glissading accident in the Sangre de Cristo Range. We ended daily backcountry avalanche forecasts on May 31.

—Brian Lazar

MOUNT WASHINGTON AVALANCHE CENTER

Early winter 2019 seems like eons ago after the dramatic changes that faced New England, and the nation, later in March. Copious late fall snow, seasonably cold weather through the winter, with very few thaw events, and a cool and snowy spring at higher elevations marked the season. Several thin melt freeze crusts developed over the course of the winter with average avalanche cycles and a half dozen or so reported human triggered avalanches over the course of the shortened season. Rain at lower elevations meant snow in the high country in late winter. The deep snowpack lingered well into July in Tuckerman Ravine and other higher elevation locations when hotter than normal temperatures arrived.

In November, snow began falling in earnest, with 55" accumulating by the last week of the month. A promotion detail for Helon Hoffer and a move back to Oregon for Ryan Matz left us shorthanded through the holidays. Jeff Fongemie and I carried the torch through January and reduced the workload by limiting our forecast products to twice-per-week General Bulletins (a.k.a. Snowpack and Avalanche Information) until Joe Soccio joined us from the Bridgeport Avalanche Center and Helon returned for the rest of the season. December brought 52" snow and January and February each 45". We issued our first daily forecast on January 4 and continued forecasting, though with a "novel" twist, until June 8th. March brought several mixed precipitation events, mostly wet snow, which would have made for fine spring skiing if it was not for the pandemic. All total, we issued 129 forecast products.

By mid-March, the rapid expansion of corona virus cases in New York (six hours drive) and Boston (three hours) had staff and volunteers concerned. Tuckerman Ravine is the mecca for spring

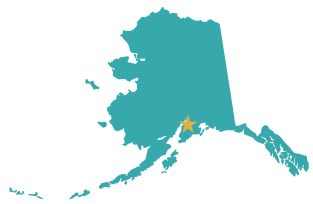
MWAC: March 18, 2020. A hiker found themselves stranded when micro spikes proved inadequate for the burly ice crust prompting the first rescue with Covid concerns.

skiing and it appeared that the closure of all nearby ski areas would contribute to even heavier use. Messages of toning down the risk taking weren't necessarily embraced, or even read, by the growing legion of new backcountry skiers. A poorly equipped hiker stranded in steep icy terrain drove home the point that our rescue resources could be quickly tapped out if two-week quarantines became necessary. As fatalities mounted in New York and Boston, the decision to close the most popular terrain on the east side of Mount Washington was clear. While we all preferred to maintain access and support outdoor activities, the throngs of beer drinking, generally ill-equipped spring skiers—the norm on spring weekends—could have hurt our small servicing hospitals as well as contribute to the spread of the virus through the north country. The closure message was delivered to the community and local skiers, climbers, and guides were very understanding if not fully supportive of the closure. After a week of tactical pause with a Forest order in place to close the east side, we began forecasting again but only provided the forecasts to rescue cooperators.

Moving forward, we look forward to a resolution of the pandemic and a return to more normal operations, though that may be awhile. Until then we plan to begin the season as usual while following best health and safety practices. The looming springtime crowds are another story with many plot twists likely before that time. We will have to wait and see what the world looks like in spring 2021. New readers should note that MWAC and Shasta Avalanche Center are the only USFS avalanche centers with rescue responsibilities. This dual role of rescuer and forecaster makes a two-week quarantine due to an exposure a real problem to normal operations. And as a local rescuer said, "avalanches don't follow you home to your family" so the new invisible threat will have to be mitigated along with the usual mountain hazards.

This summer we will be hiring two full time forecasters with duties in trails or backcountry and wilderness management on the Androscoggin Ranger District. Our Friends groups continue to be supportive and we hope to continue expanding our well received outreach events throughout New England, if not in person, then virtually. This spring, our first automated weather station began sending data. This station is located at an existing snow study plot at Hermit Lake (3,800') and will provide an hourly look at snow and weather to compliment the summit weather station and existing daily snowplot information gathered each morning at two other sites. Our expansion to cover the Presidential Range has proven generally successful and we continue to refine our data gathering and observations throughout the area.

—Frank Carus, Director



CHUGACH NATIONAL FOREST AVALANCHE INFORMATION CENTER

Hearing an Alaskan talk about a winter being cold probably doesn't seem too remarkable, but it was a COLD winter. There were multiple field days with temperatures below -20 F° and boxes of toe warmers were in high demand. Turnagain Pass, which sits very near the Gulf of Alaska and is known for its rainfall events, had a 'Continental' snow climate for only the fifth time in the past 37 years of data. In fact, the early season looked grim as it was wrought with rain and warm temperatures, capping off 2019 as officially the warmest year on record. But low and behold, a cold front moved in late New Year's Eve, dropped two feet of snow to sea level, shut down the road through Turnagain Pass and from January 1st till April very cold weather persisted. With only a few significant snowfall events, the snowpack itself struggled to stay near 50% of normal and we ended the season at 45% (with a Snow Water Equivalent of 19.7" compared to our average of 42"). There were 10 significant cold arctic air 'outflow' wind events, many causing natural wind slab avalanche cycles on clear sky days. However, riding and skiing conditions ended up fairly respectable. The snow that did fall made it to sea level and actually stuck around. The lakes and rivers froze, providing access to more zones and despite the wind events, Turnagain Pass was typically sheltered from much of the wind damage.

With a cold and thin snowpack came tricky avalanche conditions. Reactive persistent weak layers kept the avalanche danger elevated long after storms, including a very spooky deep slab problem due to a layer of January facets that lingered well into March. A large storm in mid-February initiated the most widespread deep slab avalanche cycle seen in the past 10 years. Many close calls were reported this season and very sadly, five Alaskans lost their lives in 4 different avalanche accidents across the state. One of these was just outside our forecast zone in the Chugach National Forest. A snowmachiner passed away after being caught in an avalanche in the Boulder Creek drainage south of Cooper Landing in the Kenai Mountains. Other fatalities included a snowboarder at Hatcher Pass, a snowmachiner in Dutch Harbor on the Aleutian Chain and two Haines locals were killed in an avalanche snowboarding just across the border in Canada.

When the last forecast was issued and our official statement went live, a wave of bewilderment washed over us, along with gratitude for successfully and safely operating up until close to our scheduled season's end.

CNFAIC: Ski tracks over an old natural deep slab avalanche. This slab released during a widespread natural deep slab cycle in mid-February on the popular Sunburst ridge. *Photo Billy Finley*

We had several non-snowpack noteworthy events. To name a few: the unveiling of a brand new website, welcoming new forecaster Ryan Van Luit, advances in our non-profit partnerships, successfully expanding our evening 'Avy Chat' venues and growing attendance, increasing our social media presence, tweaking our staff duties to accommodate a broken femur, and all to be capped off by ending our season two weeks short after the Governor's stay-at-home mandates on March 28th in response to the Covid-19 global pandemic. It was definitely quite the season.

It was an exciting day in early November 2019 when our new website went live. It came with a whole new look, a much-asked-for interactive 'weather map' page, and a highly anticipated mobile platform. Accomplishing this was no small task. A big thank you goes out to our non-profit group, Friends of the CNFAIC, and volunteer website assistance. Our Friends group, which provides just over 50% of our operating budget, was also hard at work hosting two very successful sold-out fundraising events, snowmachine and ski movie nights, and countless other fundraising efforts.

On March 28th, 2020 the CNFAIC made the very difficult decision to suspend our avalanche forecasting products. The decision was made in conjunction with Forest Service leadership in response to the Governor's State of Alaska Mandates to stay near your place of residence and not travel for non-essential reasons. At this point, our field operations were already restricted due to our inability to work alongside volunteer field partners per a Forest Service policy to limit contact between individuals in the early days of the virus response.

It was March 30th when the last forecast was issued and our official statement went live. A wave of bewilderment washed over us, along with gratitude for successfully and safely operating up until close to our scheduled season's end. At this point we had already reached nearly 1,000 users in 15 avalanche outreach events and only had to cancel our last on-snow awareness day at Turnagain Pass. Despite the suspension, we continued to operate full-time behind the scenes. Lead forecaster Aleph Johnston-Bloom created a 'hunker-down' list of on-line avalanche education resources. This was an effort to provide backcountry users educational material and activities to do at home; some of these were child-oriented for all the homeschooling taking place. We kept hosting our popular weekly stability meetings via teleconference joined by other local avalanche professionals in the Girdwood area. Although difficult, we collected as much weather and avalanche data as possible from our home offices, published public observations and reached out to anyone who happened to be out in the mountains. We also remained a resource for search and rescue.

CNFAIC: Snowmachine triggered large slab in the high use zone of Seattle Ridge at Turnagain Pass. One snowmachiner was caught and able to ride out of harm's way in early February. *Photo Travis Smith*

During this time, avalanche danger was relatively low, and knowing the spring shed cycle was on its way, it was important to have a plan to message when avalanche conditions worsened. The shed cycle began during out last week of operation, April 14. We posted updates via the forecast page and social media about very large wet avalanches occurring as the mountainsides fell apart. The cycle lasted only a few days and the mountains quieted down about the same time the Center shut its doors for the season.

As we plan for next winter, watching the snowplow piles melt in our driveways and welcoming the sun and warm weather, a sincere thank you goes out to the CNFAIC staff, our Forest Service leadership, our non-profit Friends group, and all the industry and business sponsors and the member/donors for their longstanding support!

—Wendy Wagner

LAST LAP

I was standing at the bottom of a classic Sawtooth couloir with my camera in hand shooting my ski partner. I looked over to this slope and saw a mountain goat punching up towards the cliff band and wondered where they were going. I took a few more photos of my ski partner and looked back to check on the goat's progress only to see a fresh crown and avalanche in motion. Luckily I had my camera in hand and captured this image. I also was impressed by the goat's mountain sense as they were on the edge of the avalanche, where the slab tapered. The goat seemed unaffected as it continued up the slope towards the cliffs. February 2017, Sawtooth Mountains, ID. *Photo Chris Marshall*

Hi Don Sharaf,

Thanks for your fine summary of the WYSAW in *The Avalanche Review* (38.3), and your point about retention.

These days I think a lot about improving retention in avalanche education (classroom, written, videos). Your point about creating 3 {points to remember} + 1{lingering question} as written notes from a talk is excellent for the students/receivers.

I'll copy this to Lynne in case this triggers an article section in a future TAR on improving retention from the presenters and receivers perspective **(working on it, Bruce—thanks!)**. Of course, non-avalanche educators have written a lot about this, so this is another opportunity to learn from outside our community.

—Bruce Jamieson

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